

The Skeletal System:

**Structure, Function, and
Diseases
of the bones and joints**

Is this the correct anatomical position?



The Skeletal System

- Parts of the skeletal system
 - Bones (skeleton)
 - Joints
 - Cartilages
 - Ligaments (bone to bone)(tendon=bone to muscle)
- Divided into two divisions
 - **Axial skeleton-** skull, spinal column
 - **Appendicular skeleton** – limbs and girdle

Functions of Bones

- **Support** of the body
- **Protection** of soft organs
- **Movement** due to attached skeletal muscles
- Storage of **minerals** and fats
- **Blood cell** formation

Bones of the Human Body

- The skeleton has **206** bones
- Two basic types of bone tissue
 - **Compact** bone
 - Homogeneous
 - **Spongy** bone
 - Small needle-like pieces of bone
 - Many open spaces

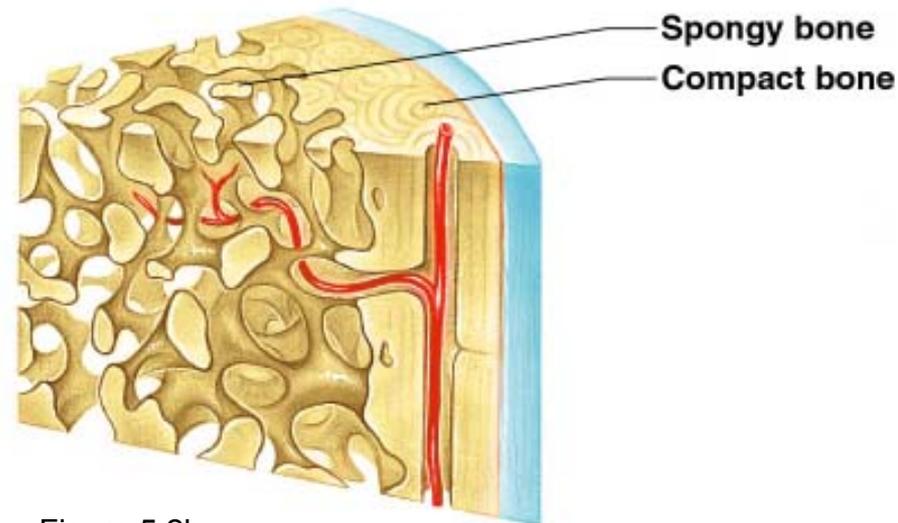


Figure 5.2b

Bones are classified by their shape:

- 1. Long-** bones are longer than they are wide (arms, legs)
- 2. Short-** usually square in shape, cube like (wrist, ankle)
- 3. Flat-** flat , curved (skull, Sternum)
- 4. Irregular-** odd shapes (vertebrae, pelvis)

Classification of Bones on the Basis of Shape

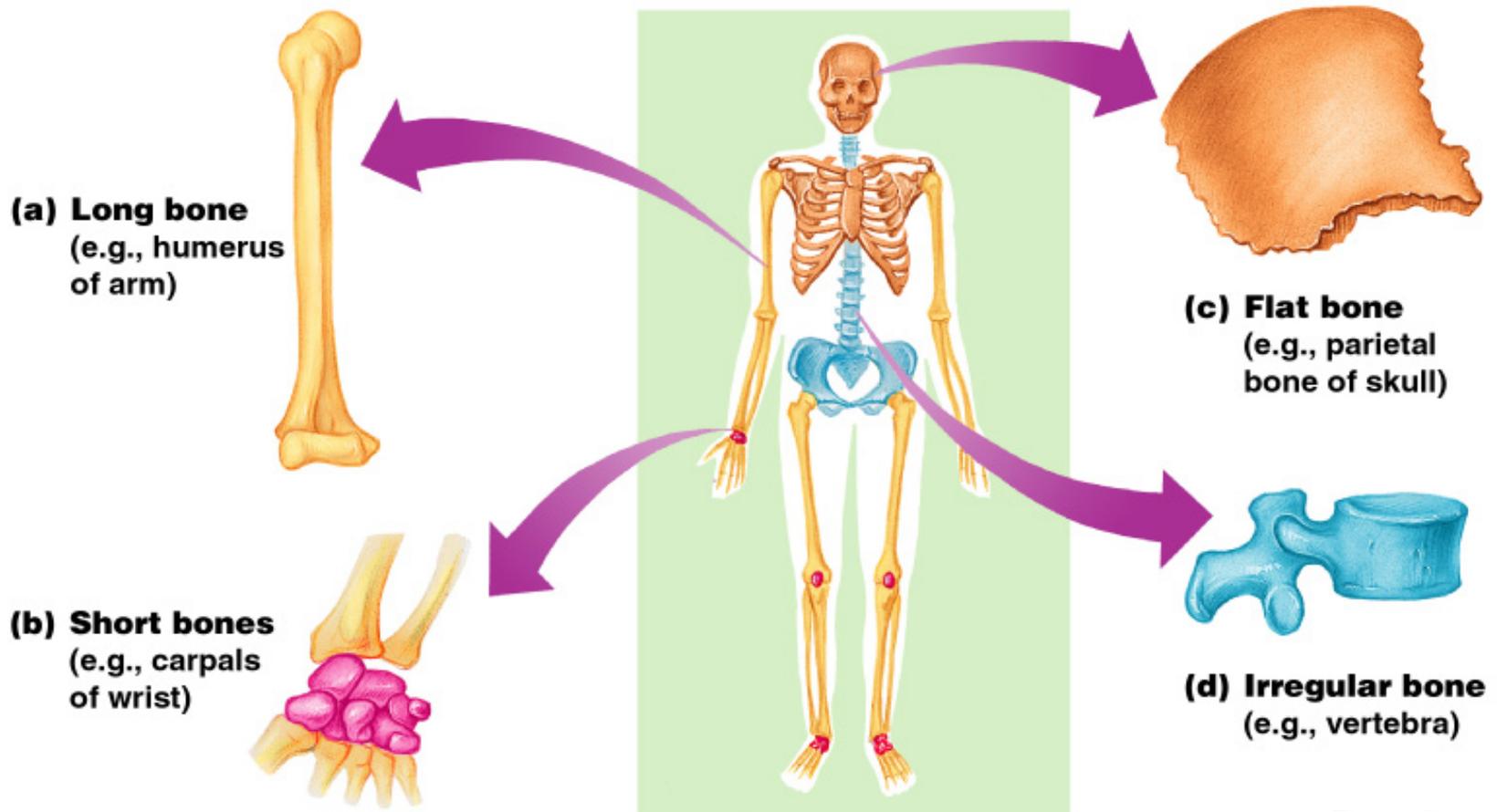


Figure 5.1

Types of Bone Cells

- **Osteocytes**
 - Mature bone cells
- **Osteoblasts**
 - Bone-forming cells
- **Osteoclasts**
 - Bone-destroying cells
 - Break down bone matrix for remodeling and release of calcium
- ***Bone remodeling is a process by both osteoblasts and osteoclasts***

Changes in the Human Skeleton

- In **embryos**, the skeleton is primarily hyaline ***cartilage***
- During development, much of this cartilage is replaced by bone
- Cartilage remains in isolated areas
 - Bridge of the nose
 - Parts of ribs
 - Joints

Bone Fractures

- ***A break in a bone***
- Types of bone fractures
 - Closed (**simple**) fracture – break that does not penetrate the skin
 - Open (**compound**) fracture – broken bone penetrates through the skin
 - **Greenstick-** frays, hard to repair, breaks like a green twig
- Bone fractures are treated by ***reduction*** and ***immobilization***
 - Realignment of the bone

Axial skeleton supports and protects organs of head, neck and trunk

Axial skeleton:

skull (cranium and facial bones)

hyoid bone (anchors tongue and muscles

associated with swallowing)

vertebral column (vertebrae and disks)

bony thorax (ribs and sternum)

Appendicular skeleton includes bones of limbs and bones that anchor them to the axial skeleton

Appendicular skeleton:

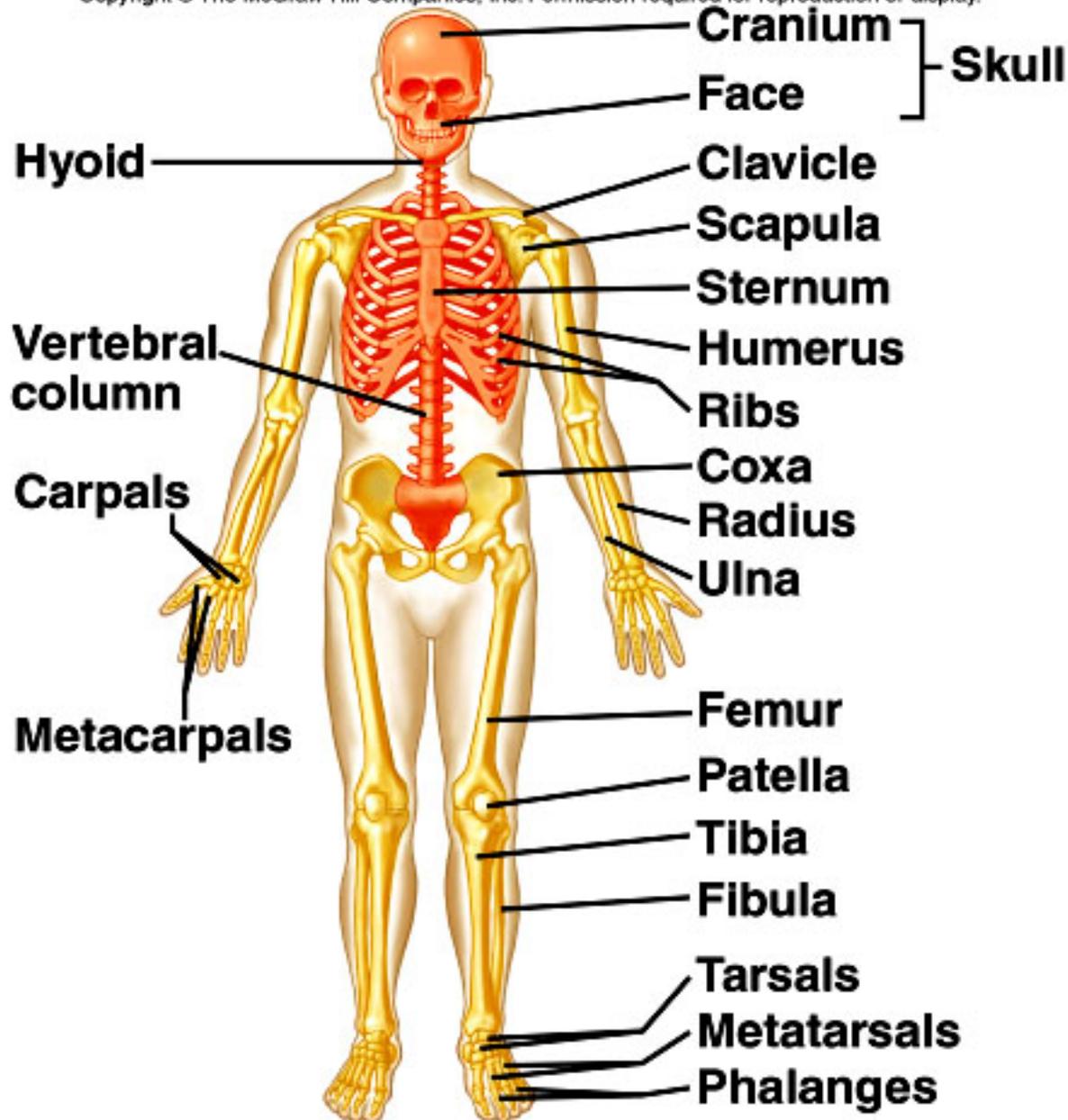
pectoral girdle (clavicle, scapula)

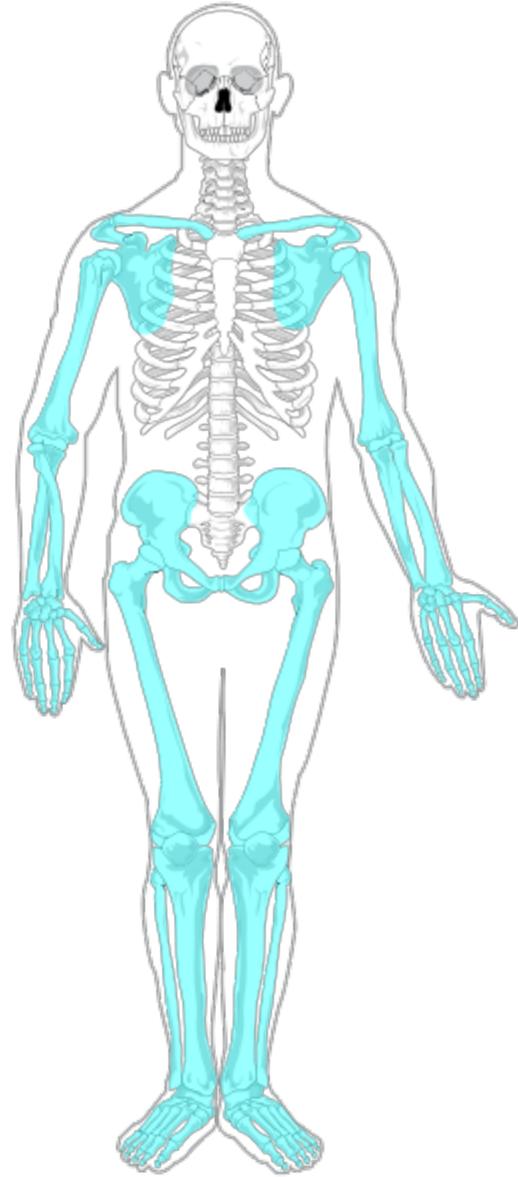
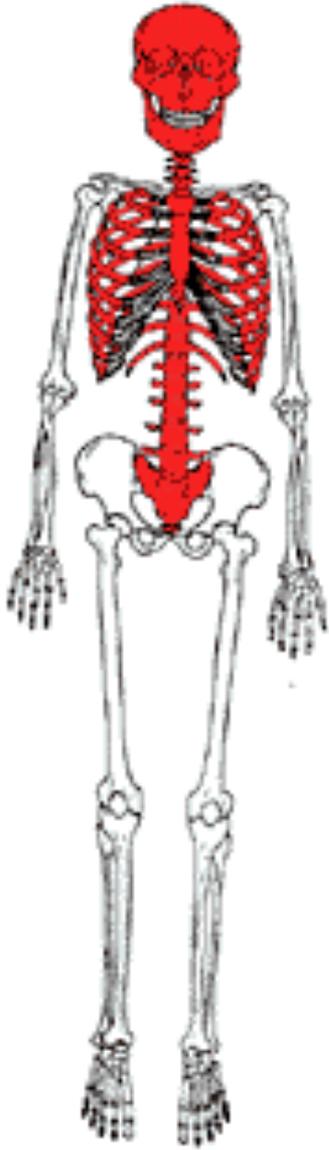
upper limbs (arms)

pelvic girdle (sacrum, coccyx)

lower limbs (legs)

Articulation- where joints meet, connect, and are formed.





The Axial Skeleton

- Forms the longitudinal part of the body
- Divided into three parts
 - ***Skull***
 - ***Vertebral Column***
 - ***Rib Cage***

The Axial Skeleton

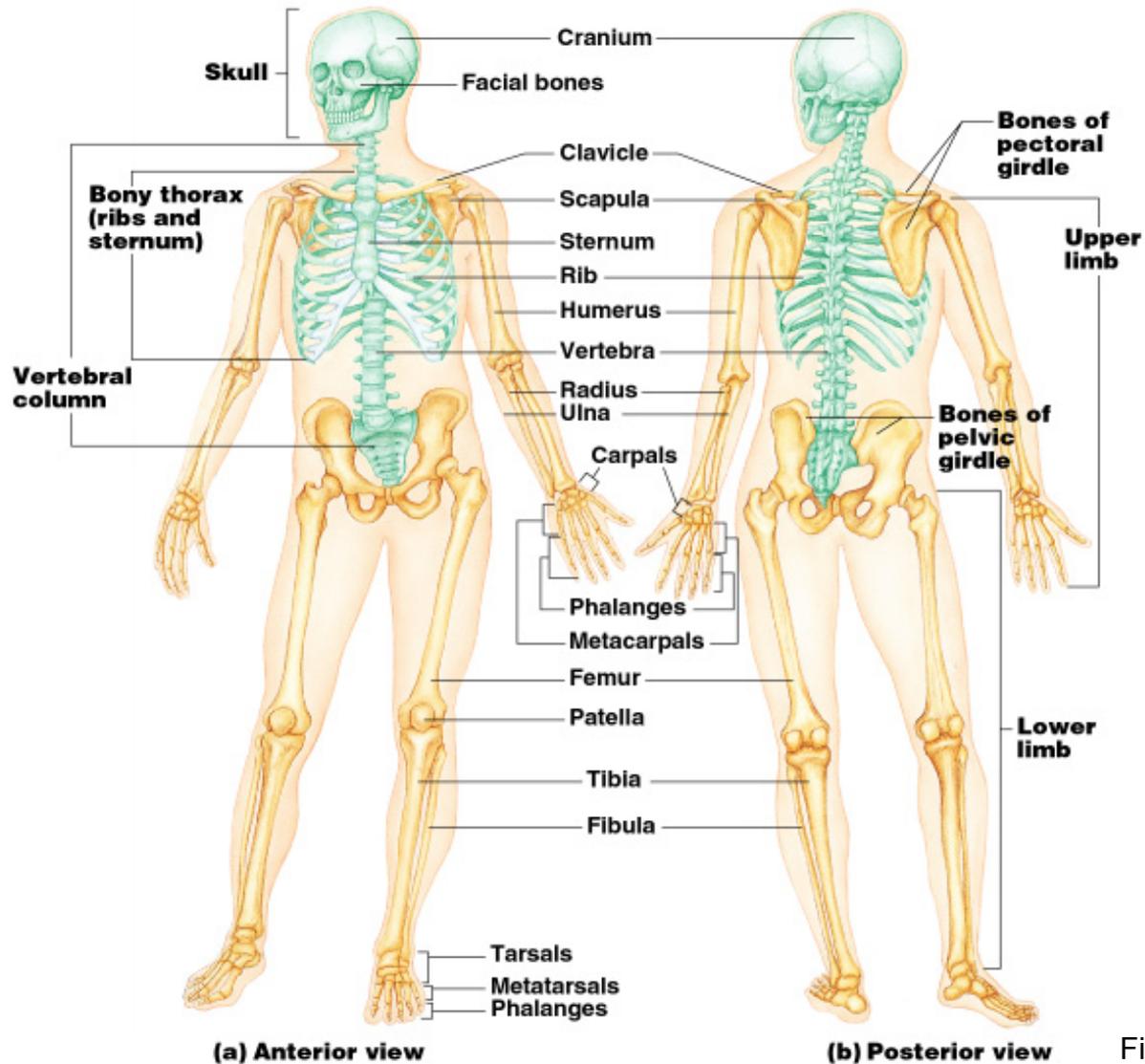


Figure 5.6

The Skull

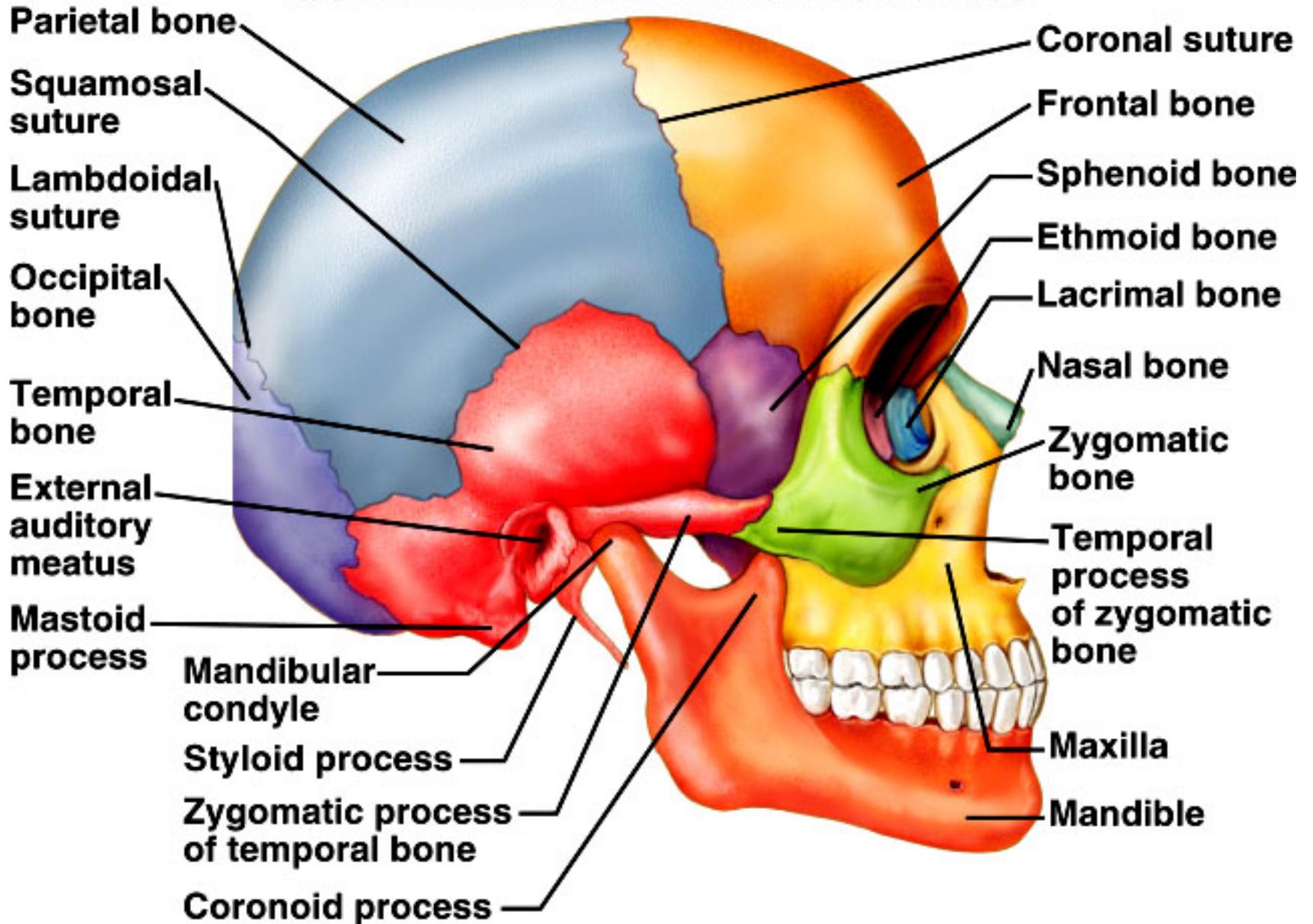
- 8 sutured bones in cranium
- Facial bones: 13 sutured bones 1 mandible

Cranium

encases brain

attachments for muscles

sinuses



Bones of the Skull

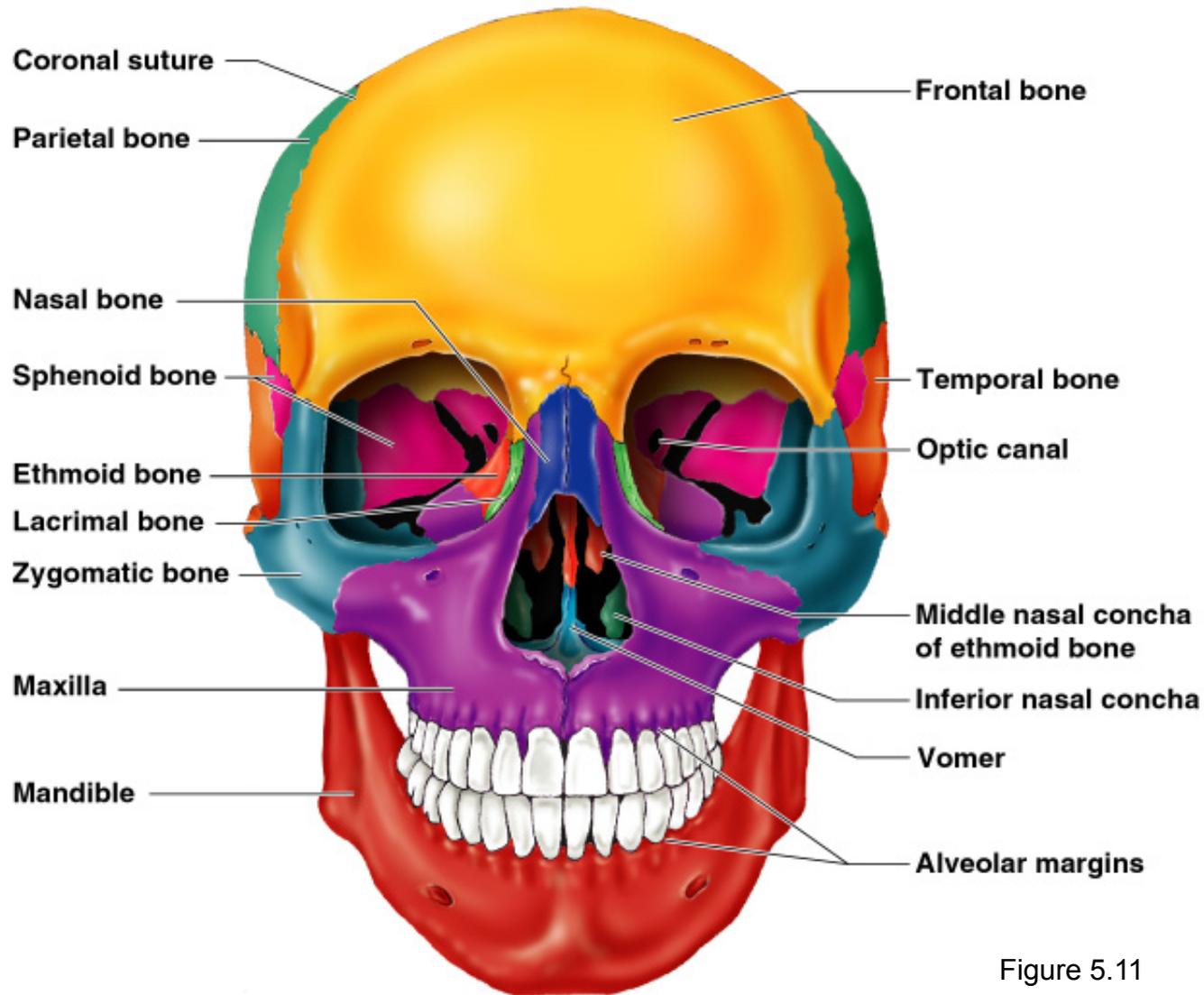
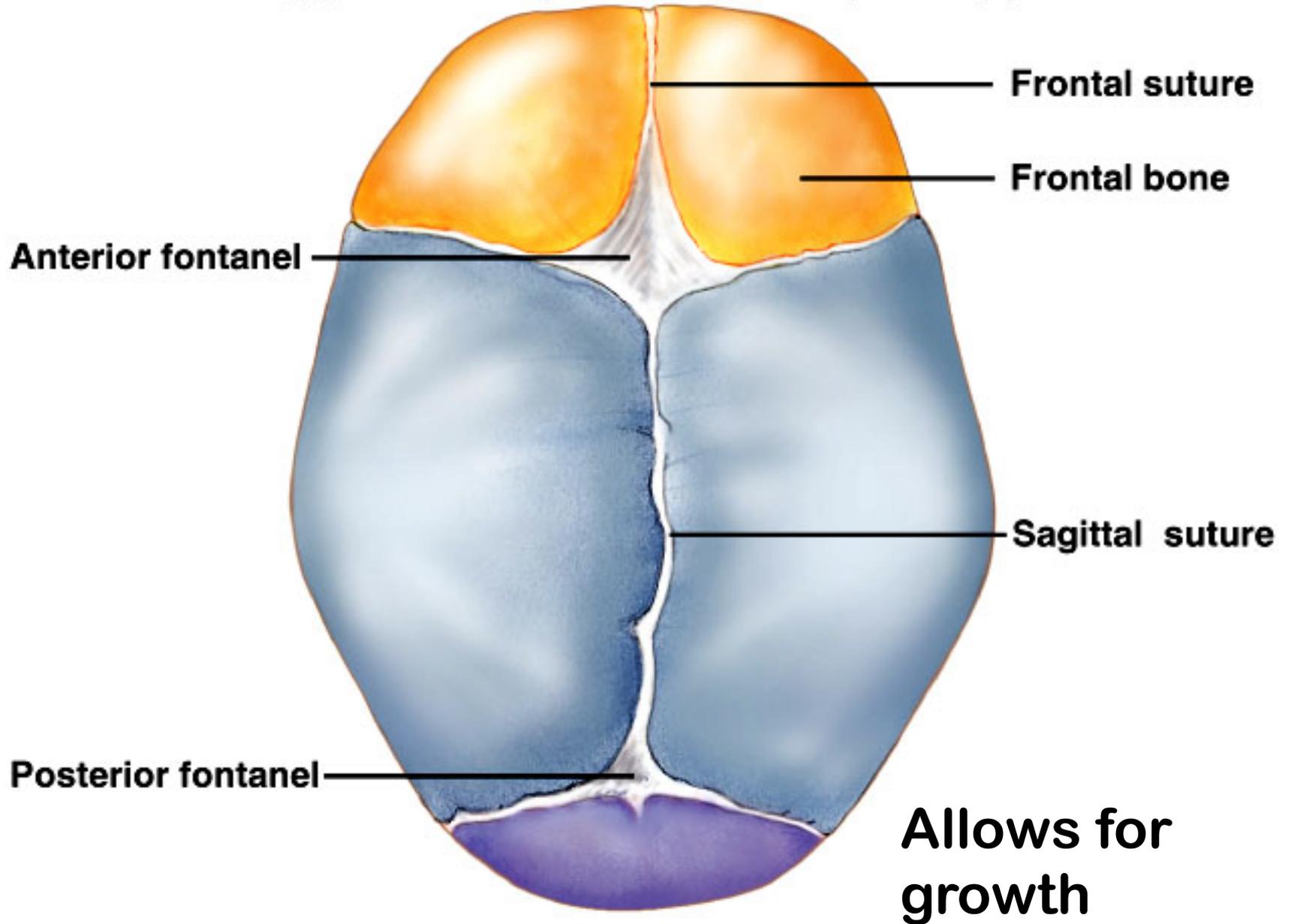
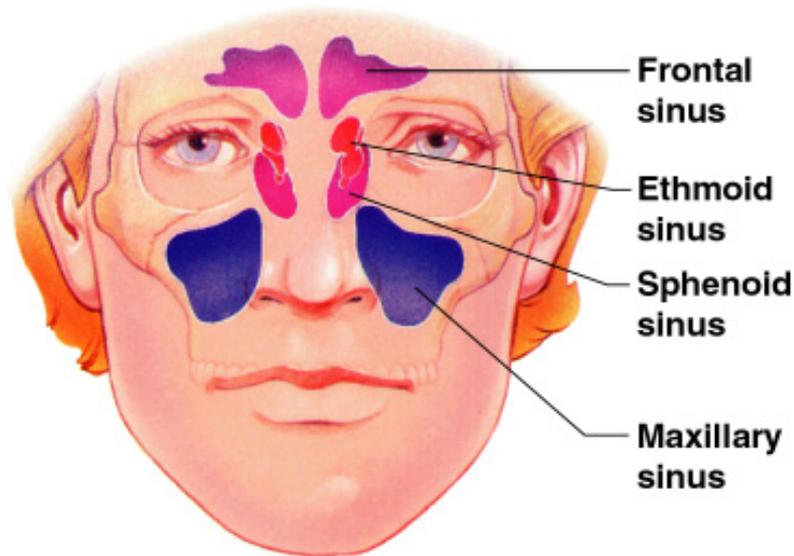


Figure 5.11

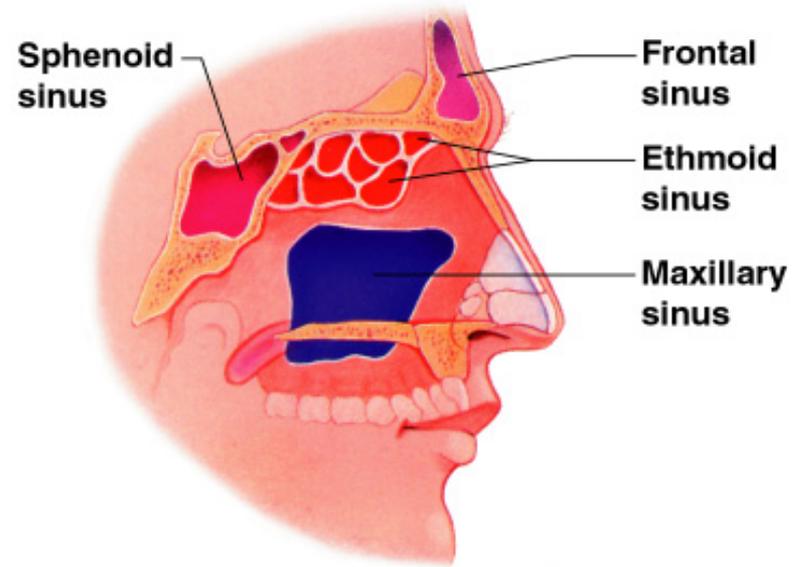


Paranasal Sinuses

- Hollow portions of bones surrounding the nasal cavity



(a)



(b)

Figure 5.10

The Hyoid Bone

- The only bone that does not articulate with another bone
- Serves as a moveable base for the tongue, and other muscle attachments

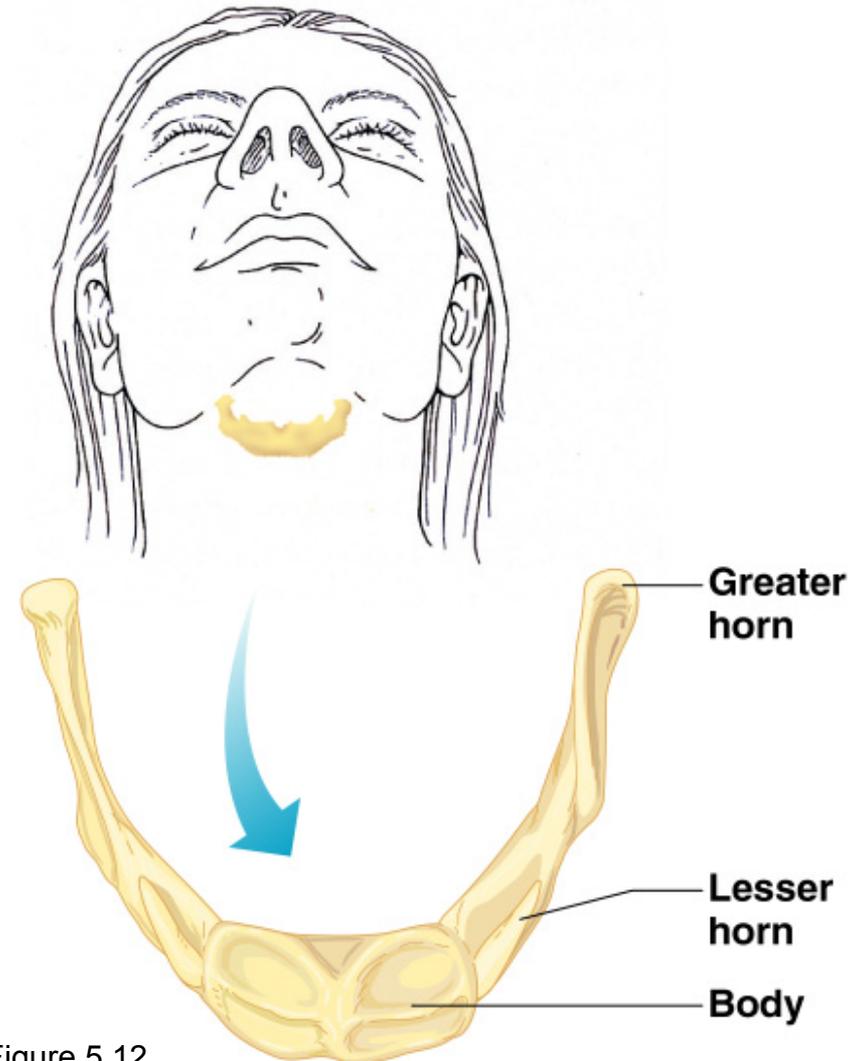


Figure 5.12

The Vertebral Column

- Vertebrae separated by intervertebral discs made of cartilage
- The spine has a normal S curvature
- Each vertebrae is given a name according to its location

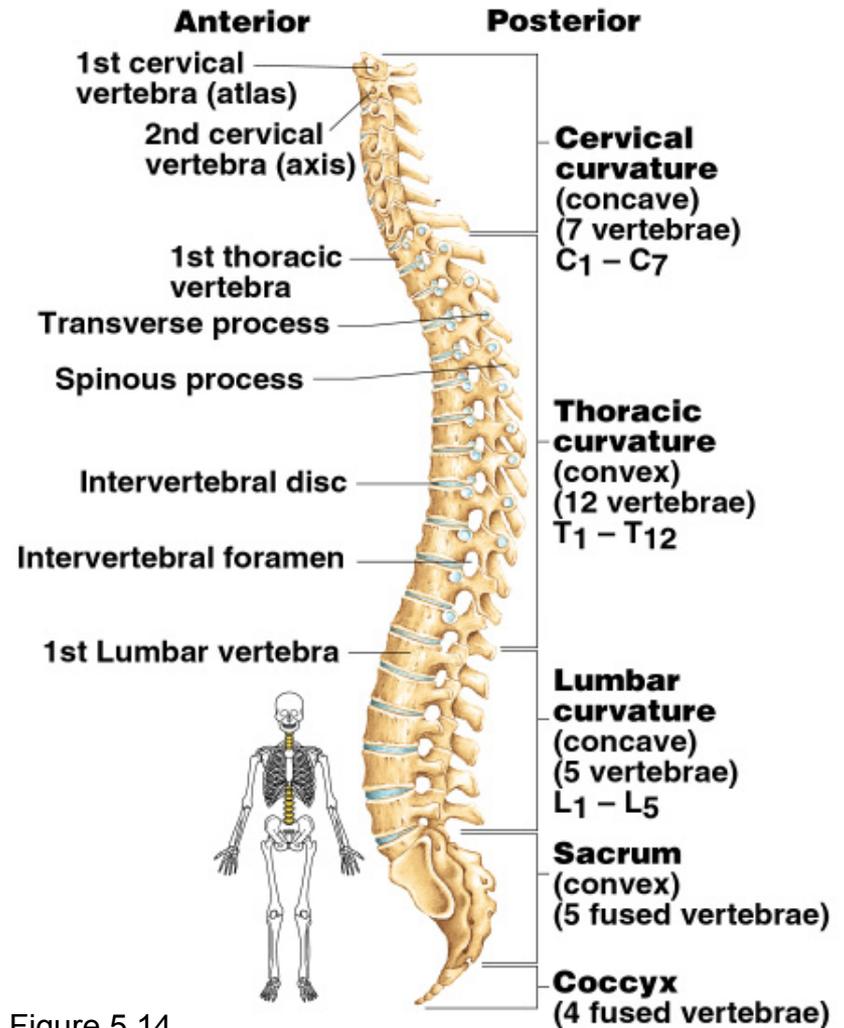
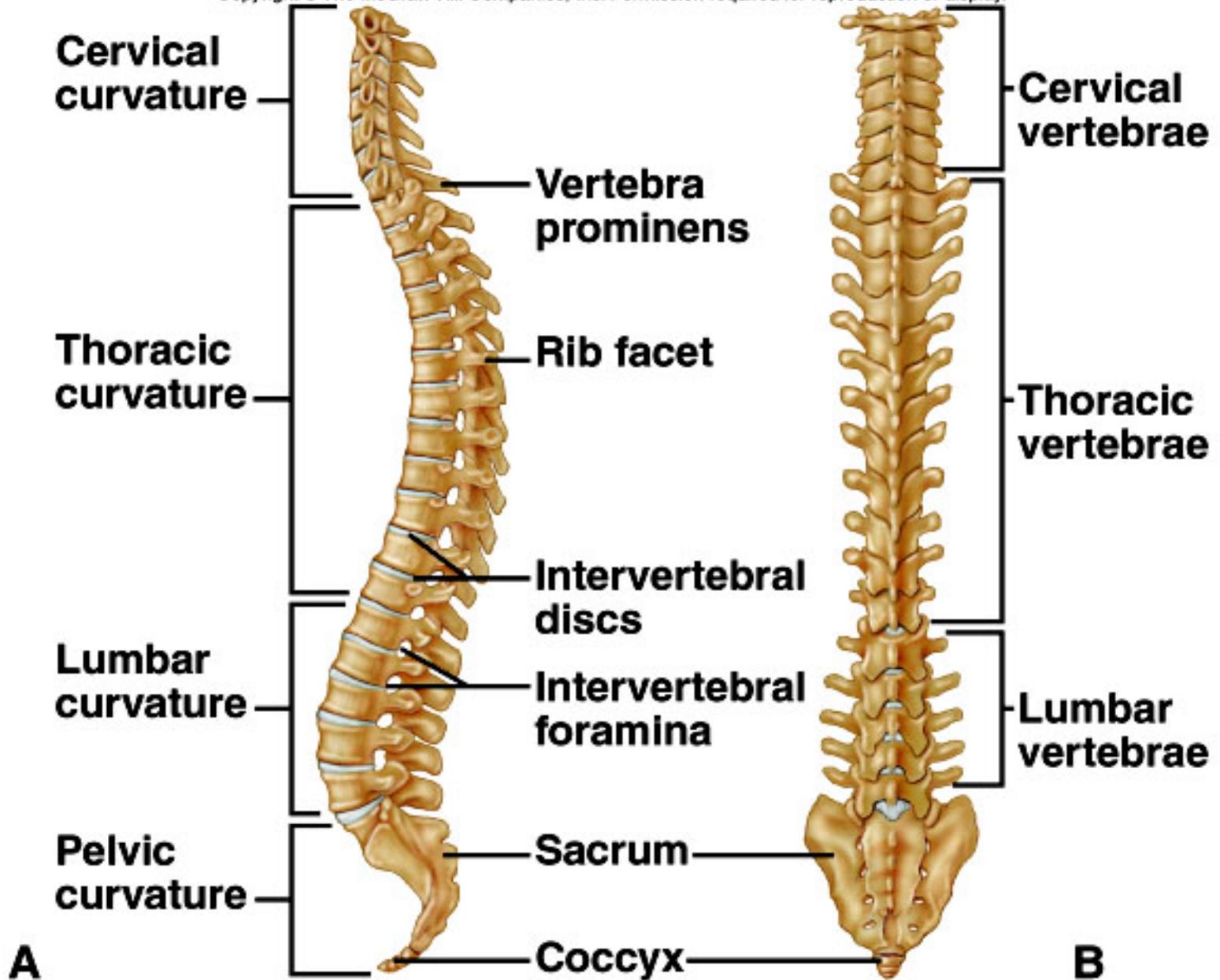


Figure 5.14



Thoracic cage

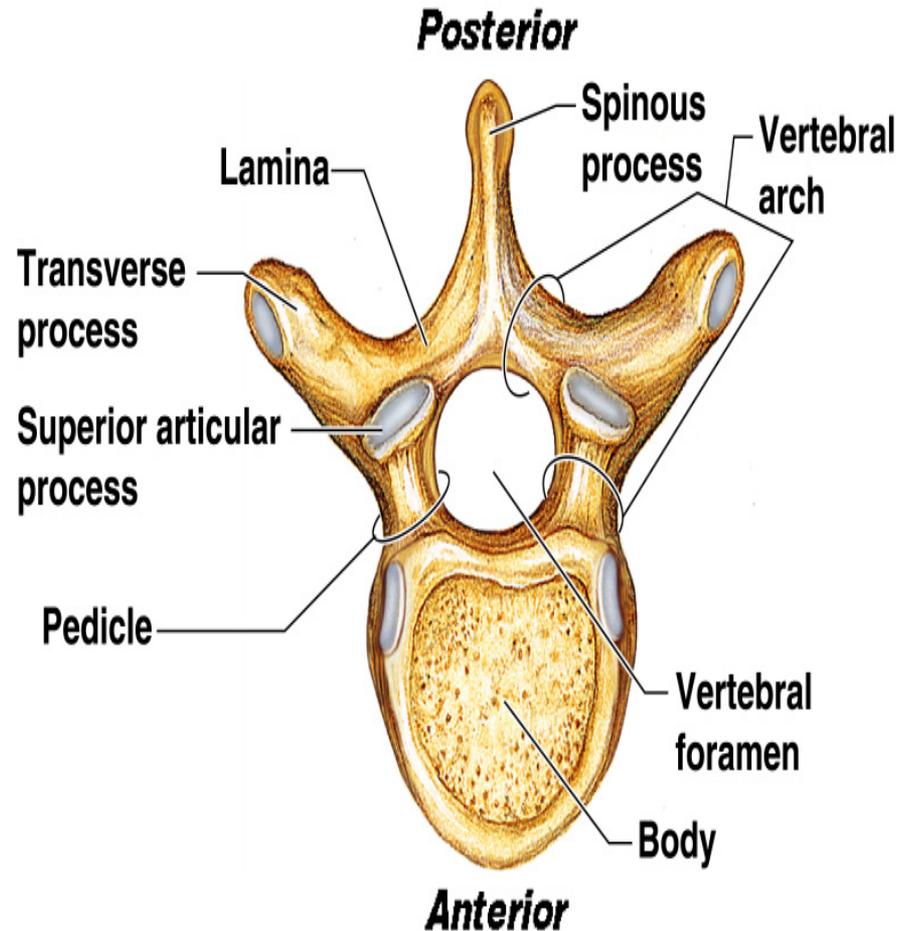
ribs

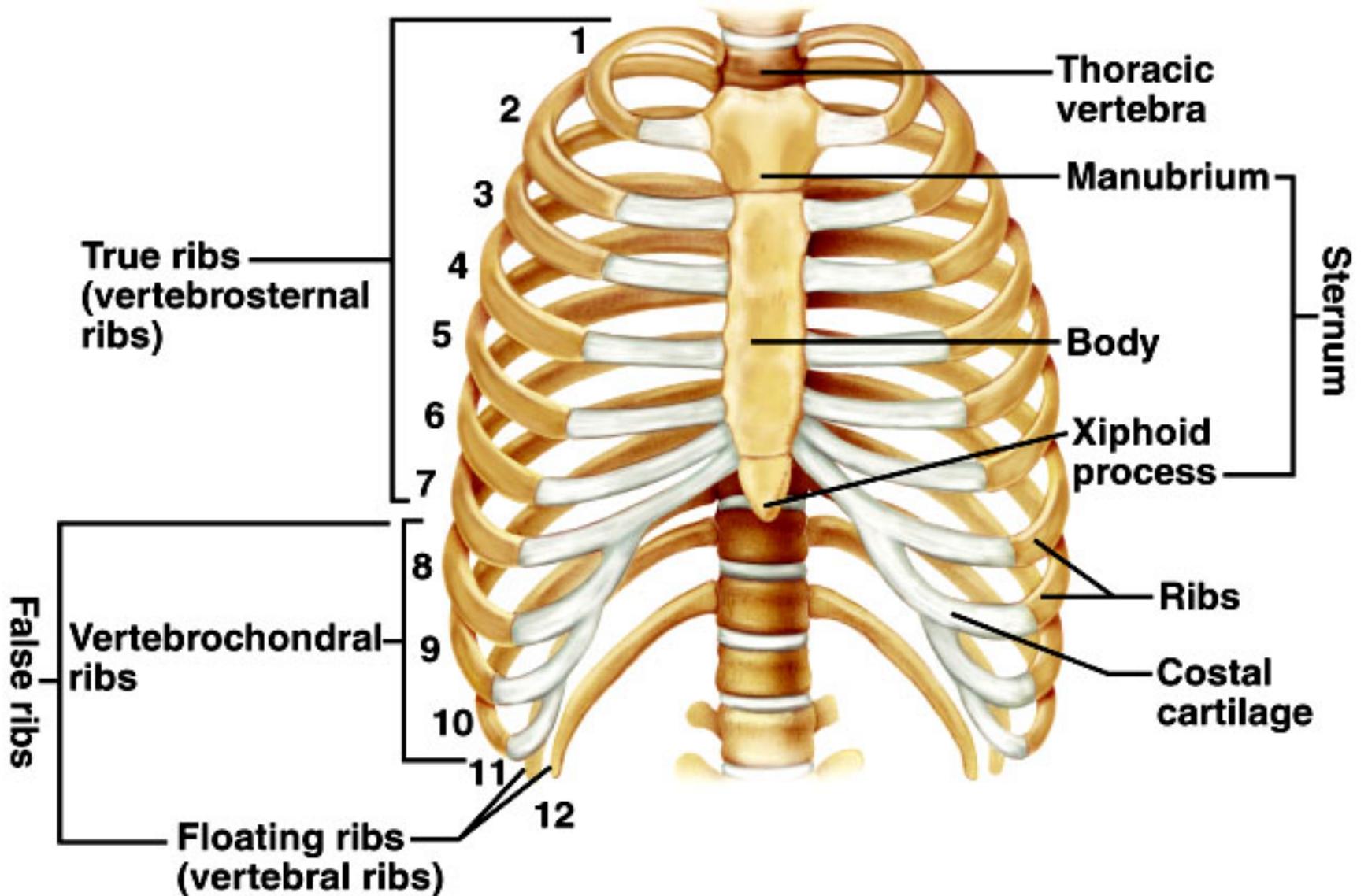
thoracic **Vertebrae**

sternum

costal cartilages

- True ribs are directly attached to the sternum (first seven pairs)
- Three false ribs are joined to the 7th rib
- Two pairs of floating ribs





Joints

A joint, or articulation, is the place where two bones come together.

- **Fibrous- Immovable:** connect bones, no movement. (skull and pelvis).
- **Cartilaginous- slightly movable,** bones are attached by cartilage, a little movement (spine or ribs).
- **Synovial- freely movable,** much more movement than cartilaginous joints. Cavities between bones are filled with synovial fluid. This fluid helps lubricate and protect the bones.

The Synovial Joint

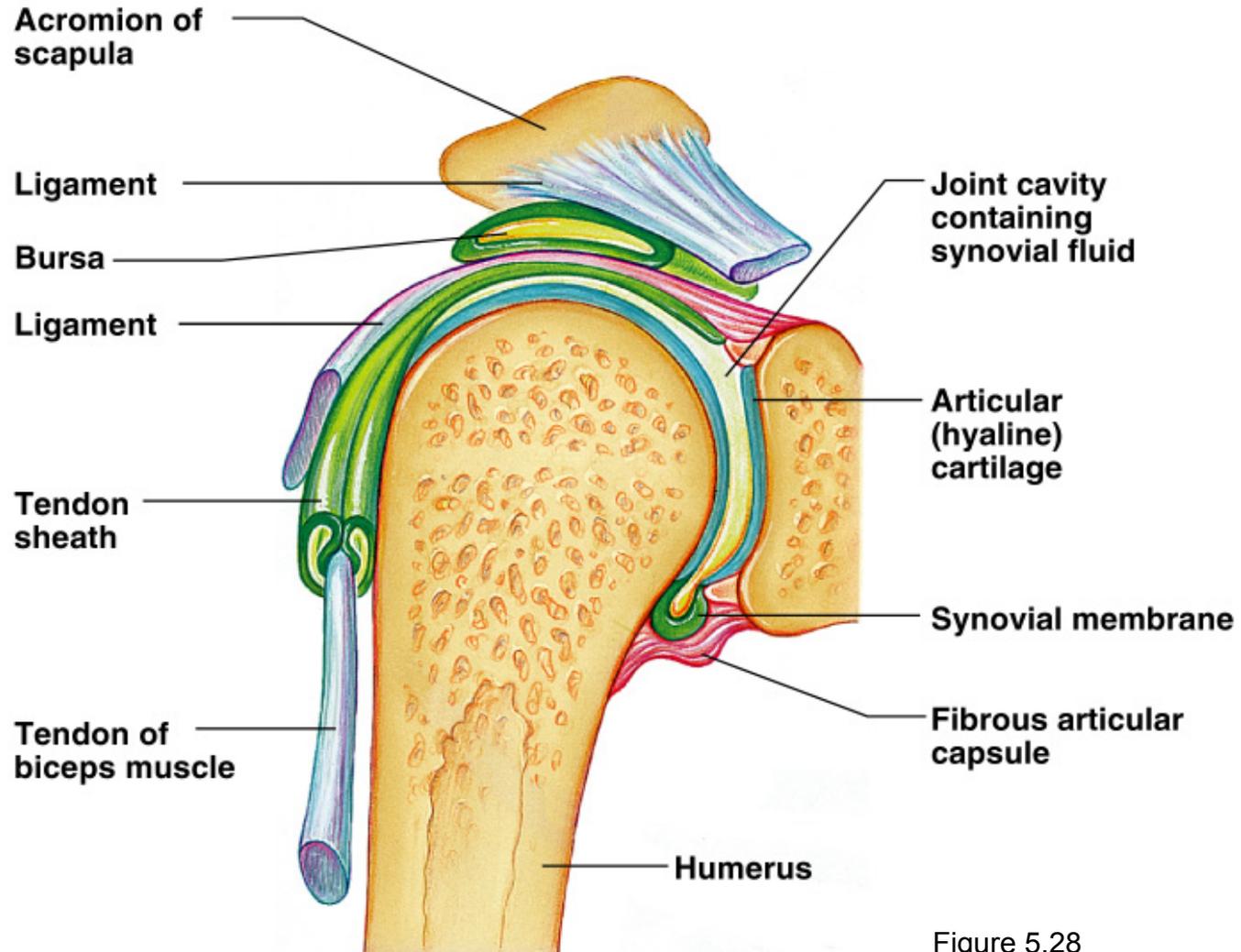


Figure 5.28

Types of Synovial Joints Based on Shape

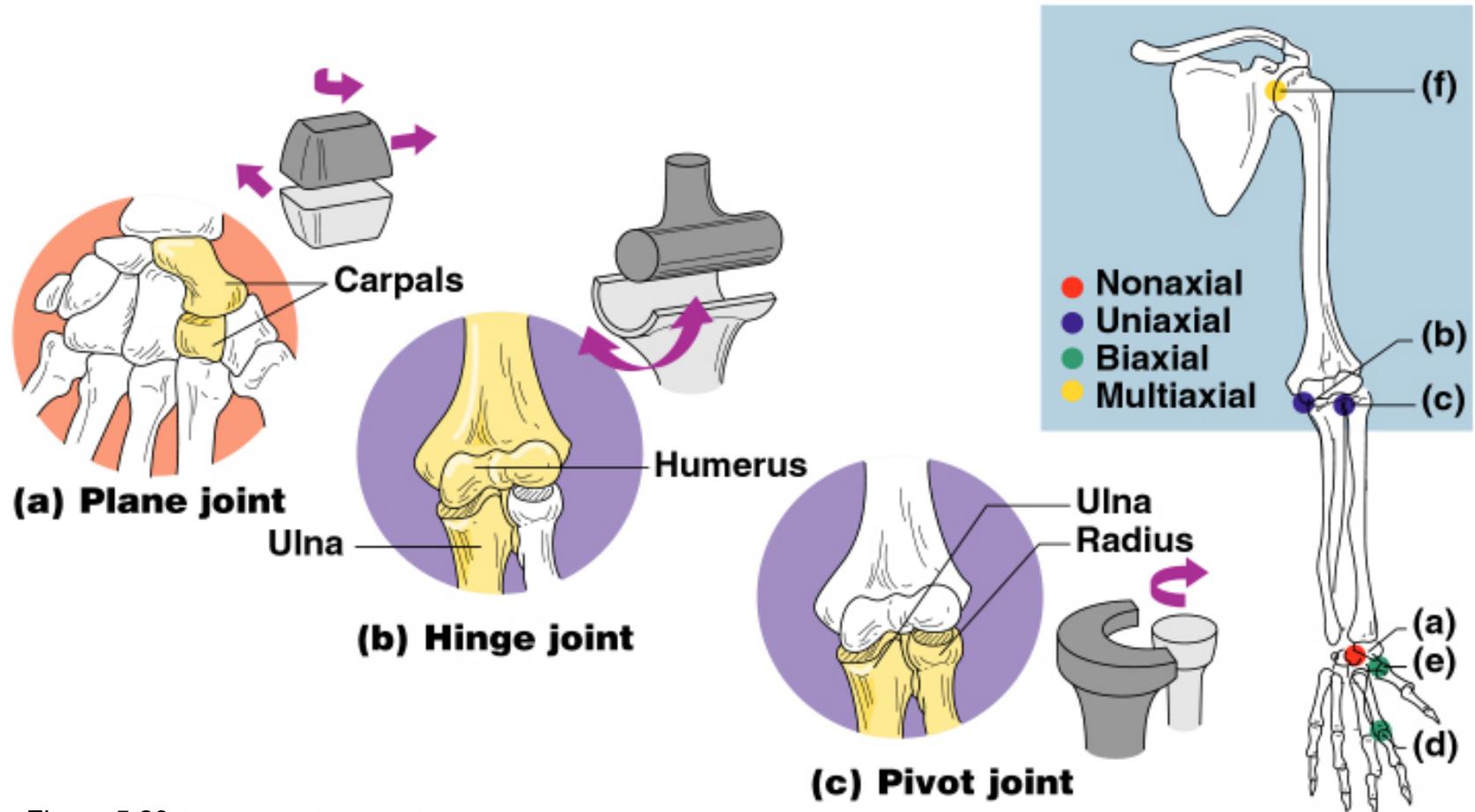


Figure 5.29a–c

Types of Synovial Joints Based on Shape

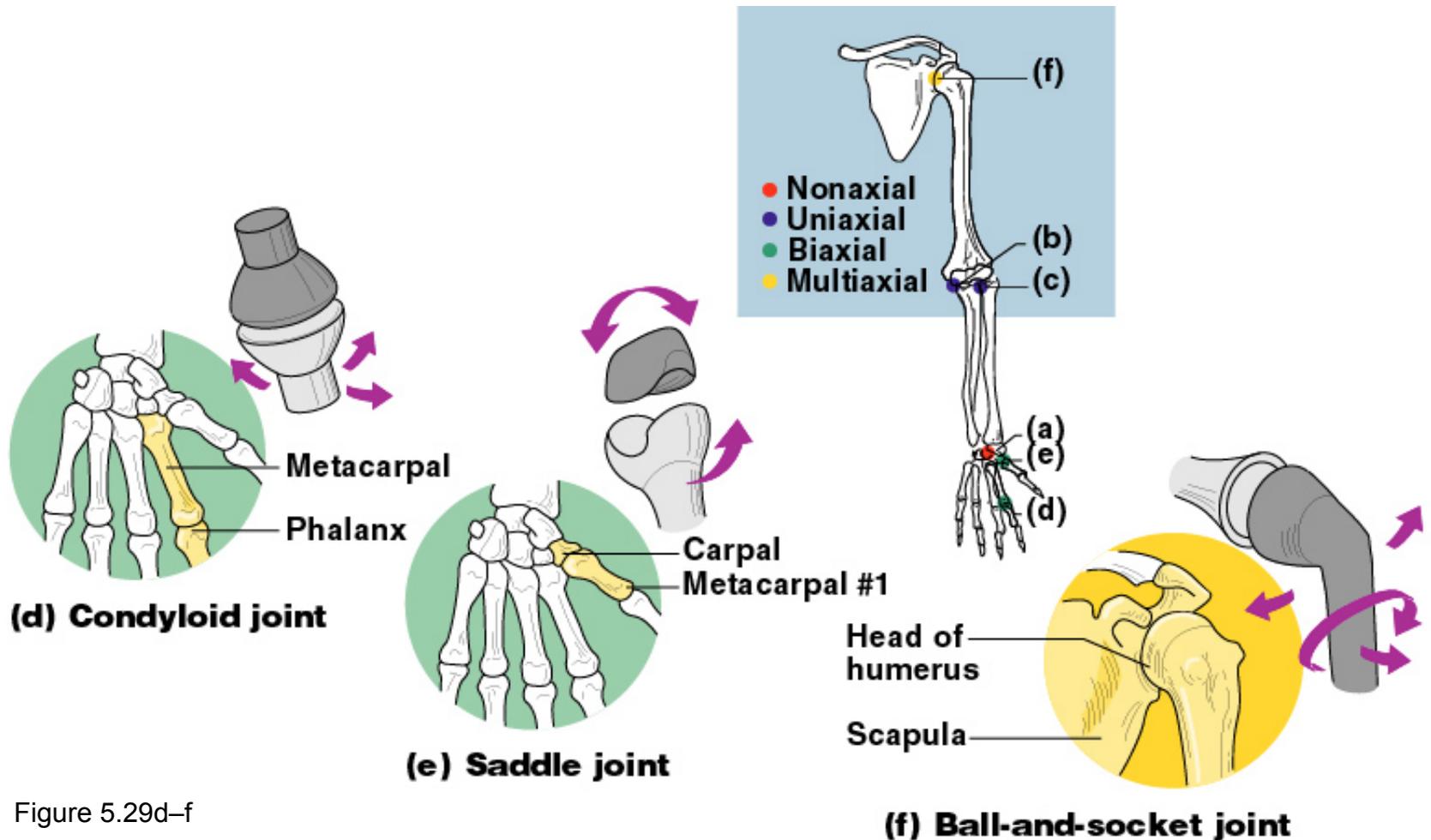


Figure 5.29d-f

Types of Joints

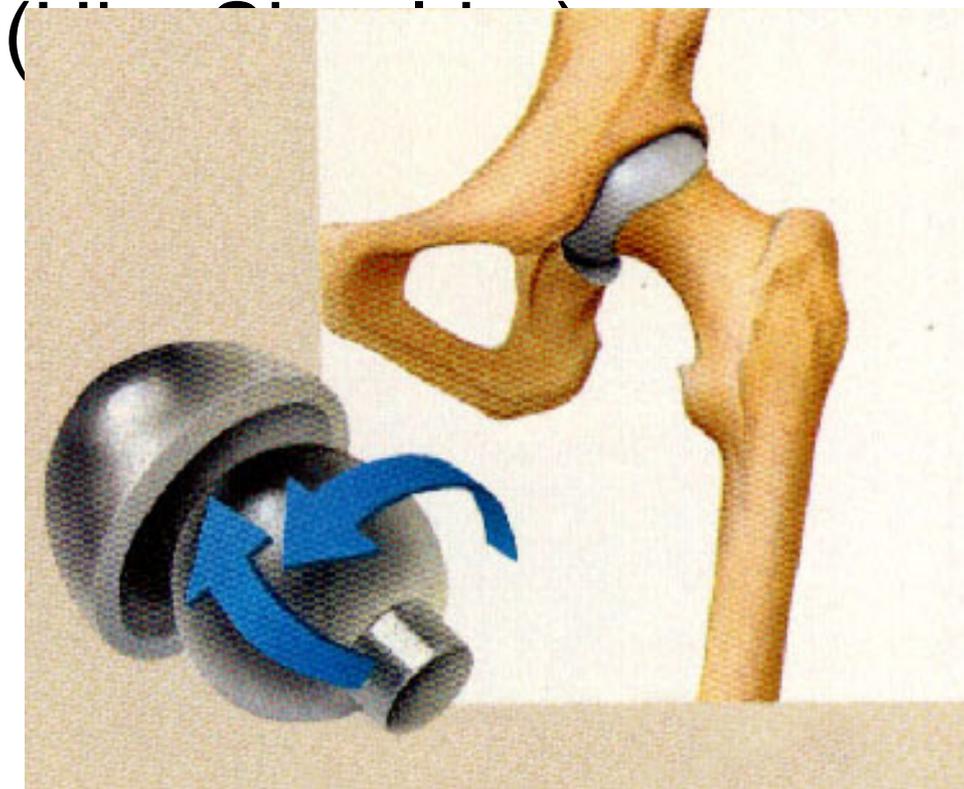
Hinge-

A hinge joint allows extension and retraction of one bone on another (Elbow, Knee)



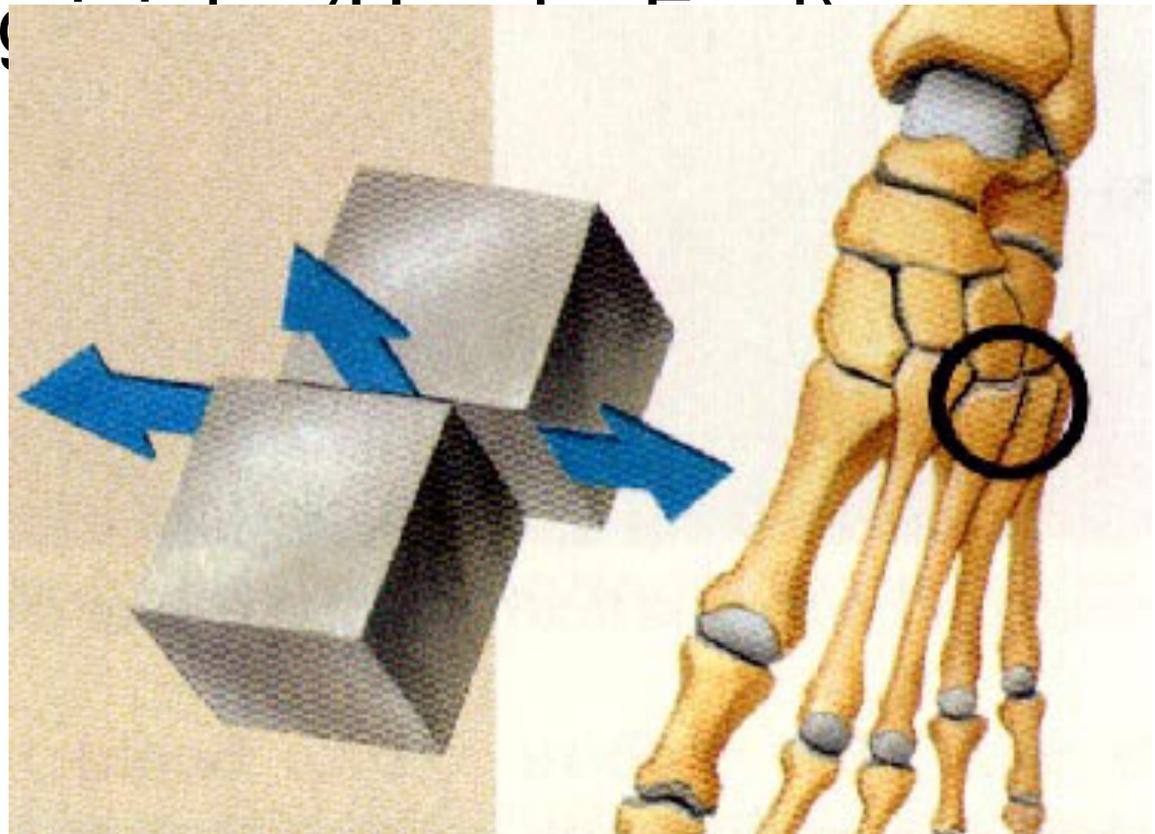
Ball and Socket-

A ball and socket joint allows for radial movement in almost any direction. They are found in the hips and shoulders.

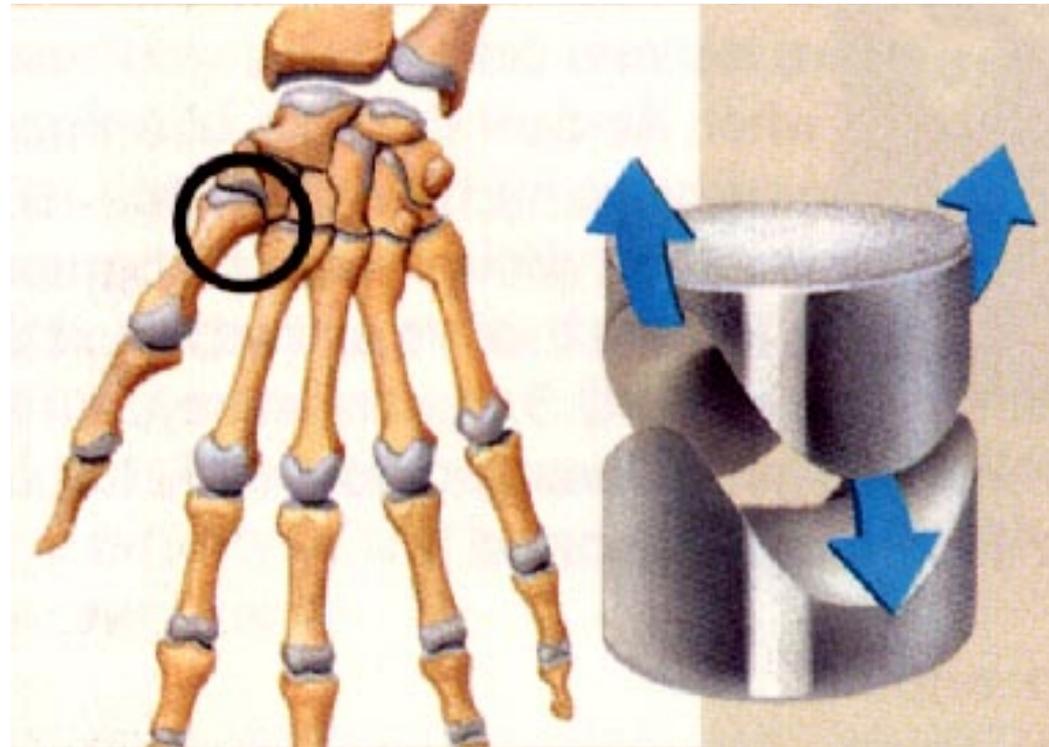


Gliding-

In a gliding or plane joint bones slide past each other. Mid-carpal and mid-tarsal joints are gliding

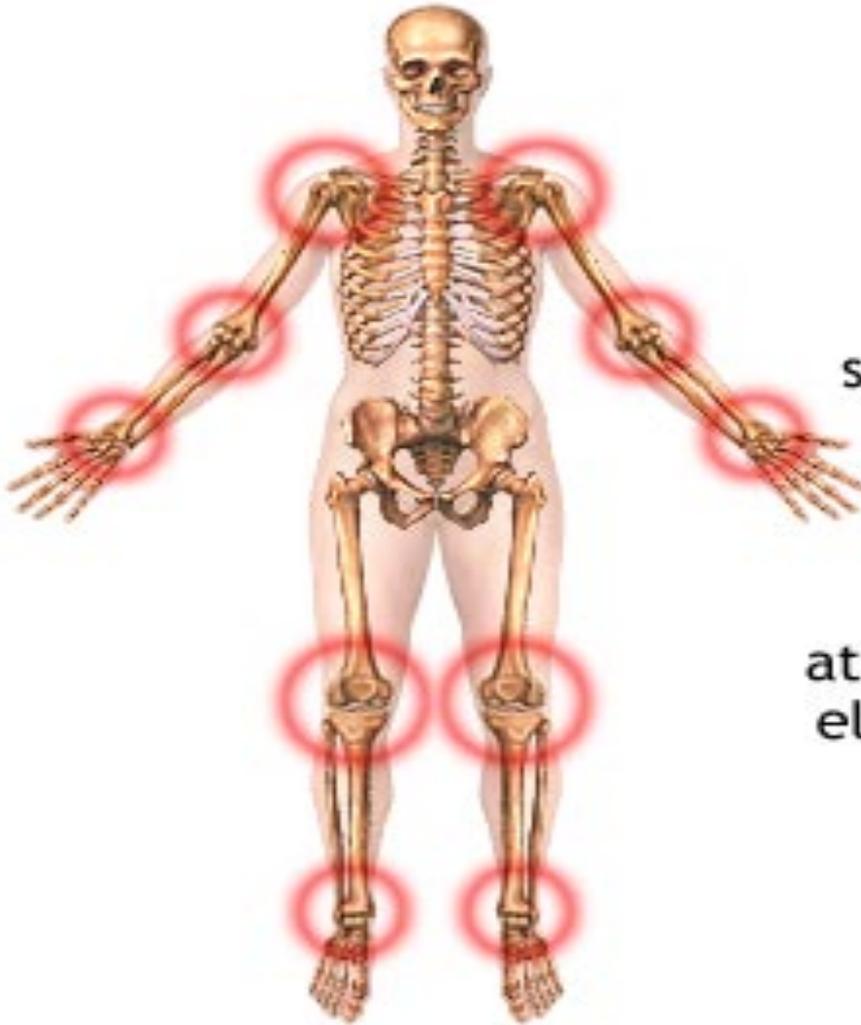


Saddle- This type of joint occurs when the touching surfaces of two bones have both concave and convex regions with the shapes of the two bones complementing one other and allowing a wide range of movement. (Thumb)



Diseases and Conditions of the Skeletal System

Arthritis



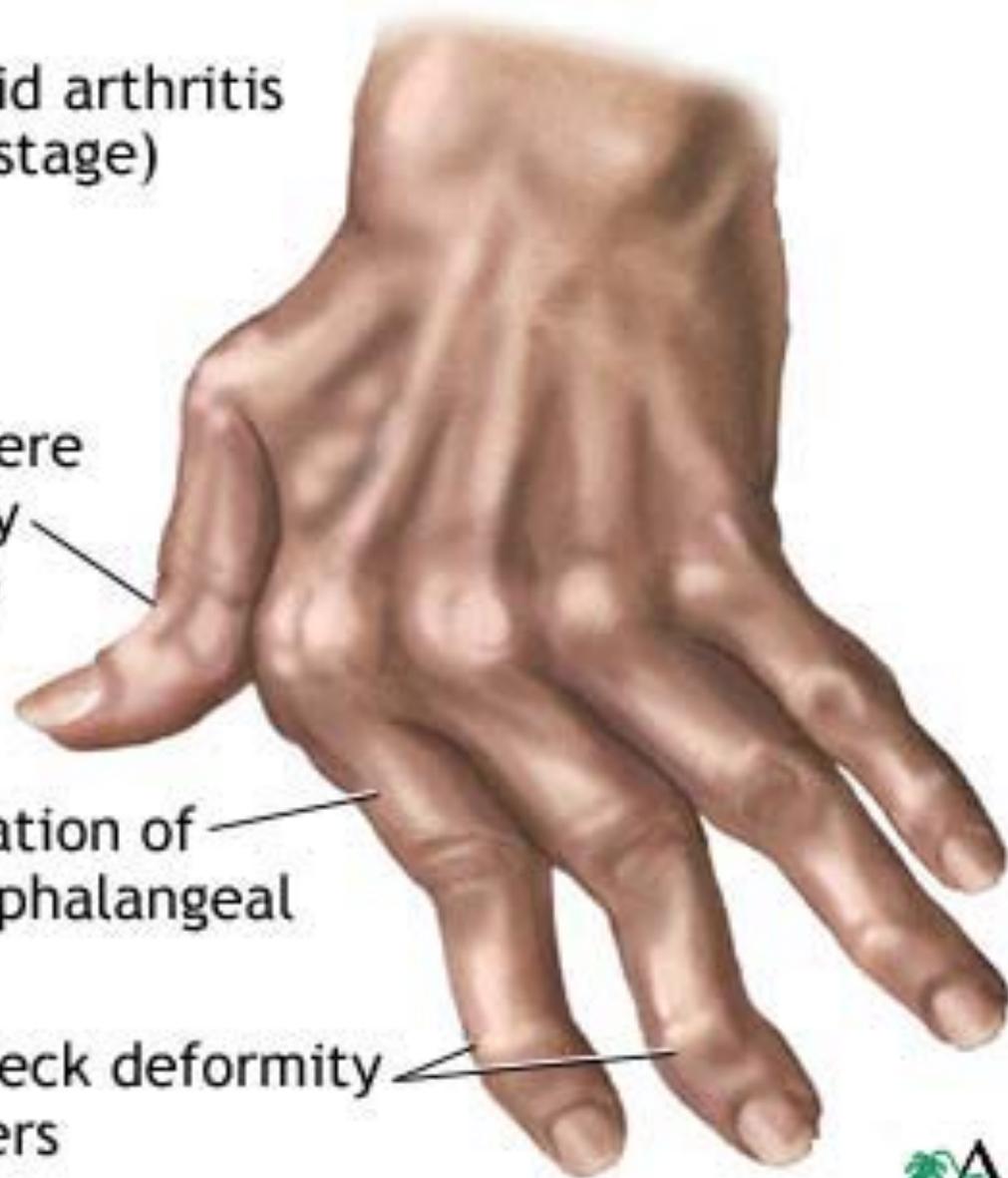
Rheumatoid arthritis usually affects joints symmetrically (on both sides equally), may initially begin in a couple of joints only, and most frequently attacks the wrists, hands, elbows, shoulders, knees and ankles

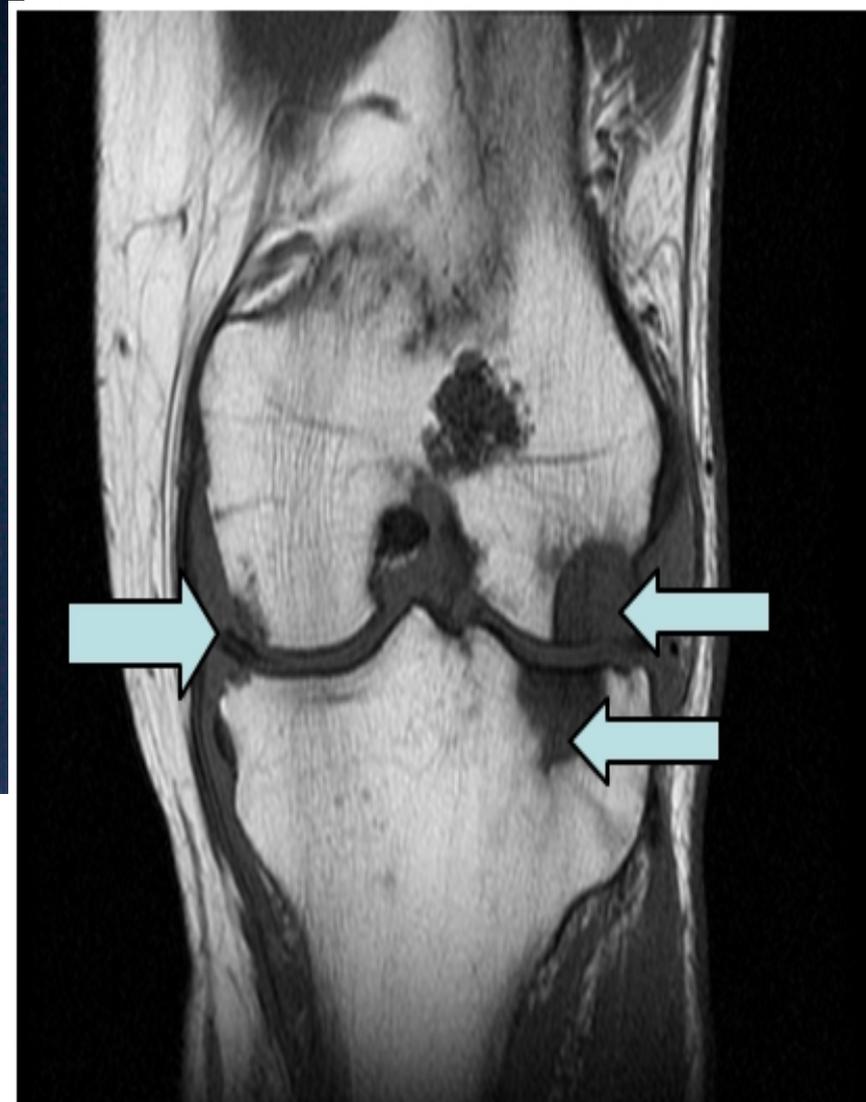
Rheumatoid arthritis
(late stage)

Boutonniere
deformity
of thumb

Ulnar deviation of
metacarpophalangeal
joints

Swan-neck deformity
of fingers







Bursitis

- Inflammation of the Bursa (fluid filled sac surrounding the joint).
- A bursa can become inflamed from injury, infection (rare in the shoulder), or due to an underlying rheumatic condition.
- Bursitis is typically identified by localized pain or swelling, tenderness, and pain with motion of the tissues in the affected area.

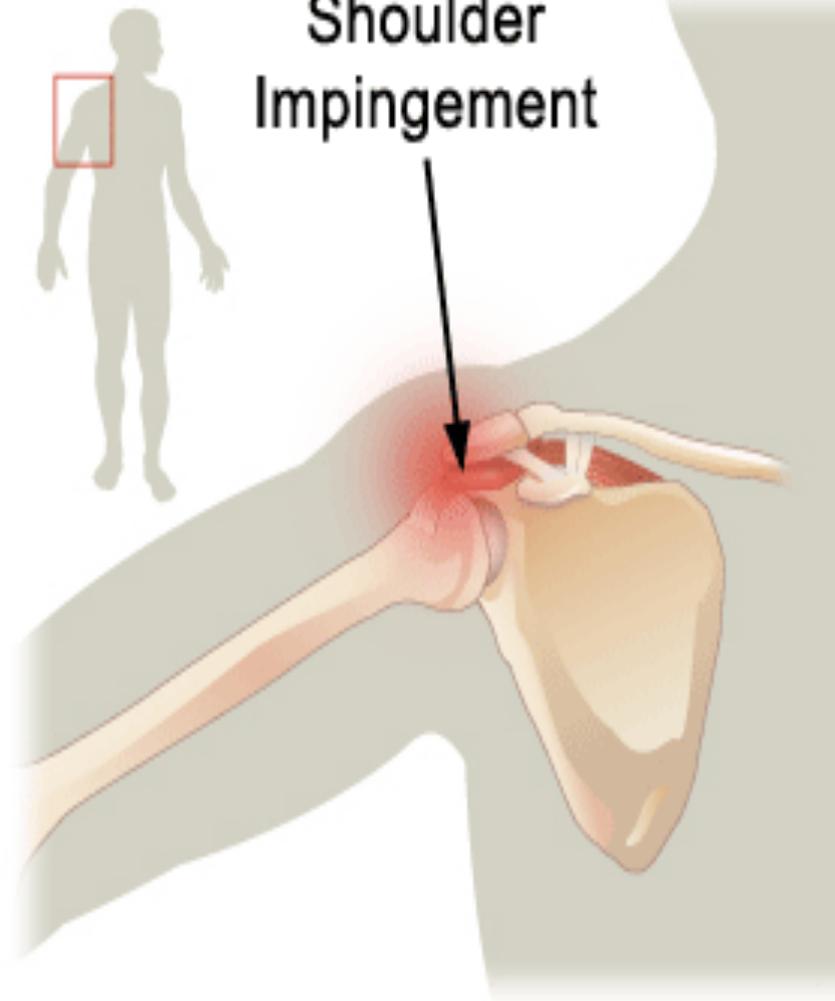




Tendonitis

- Sometimes the tendons become inflamed for a variety of reasons, and the action of pulling the muscle becomes irritating. If the normal smooth gliding motion of your tendon is impaired, the tendon will become inflamed and movement will become painful. This is called tendonitis, and literally means inflammation of the tendon.
- The most common cause of tendonitis is overuse.

Shoulder Impingement



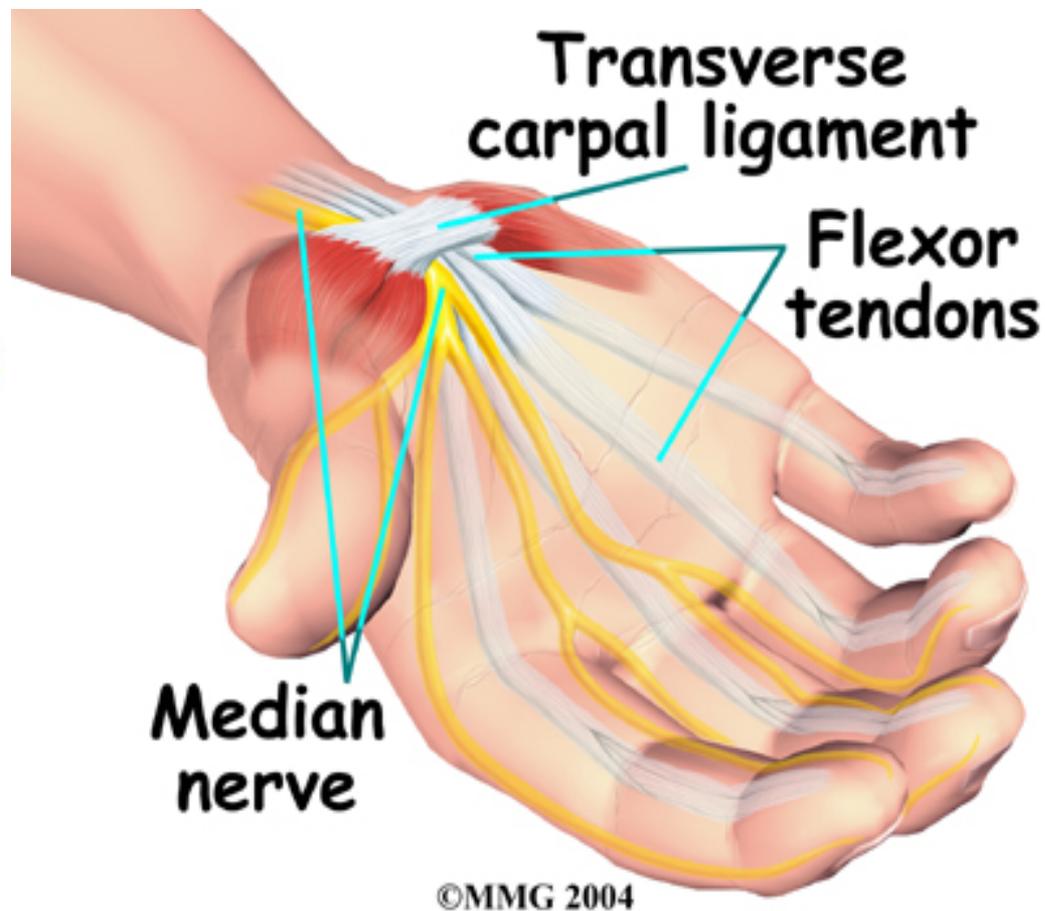
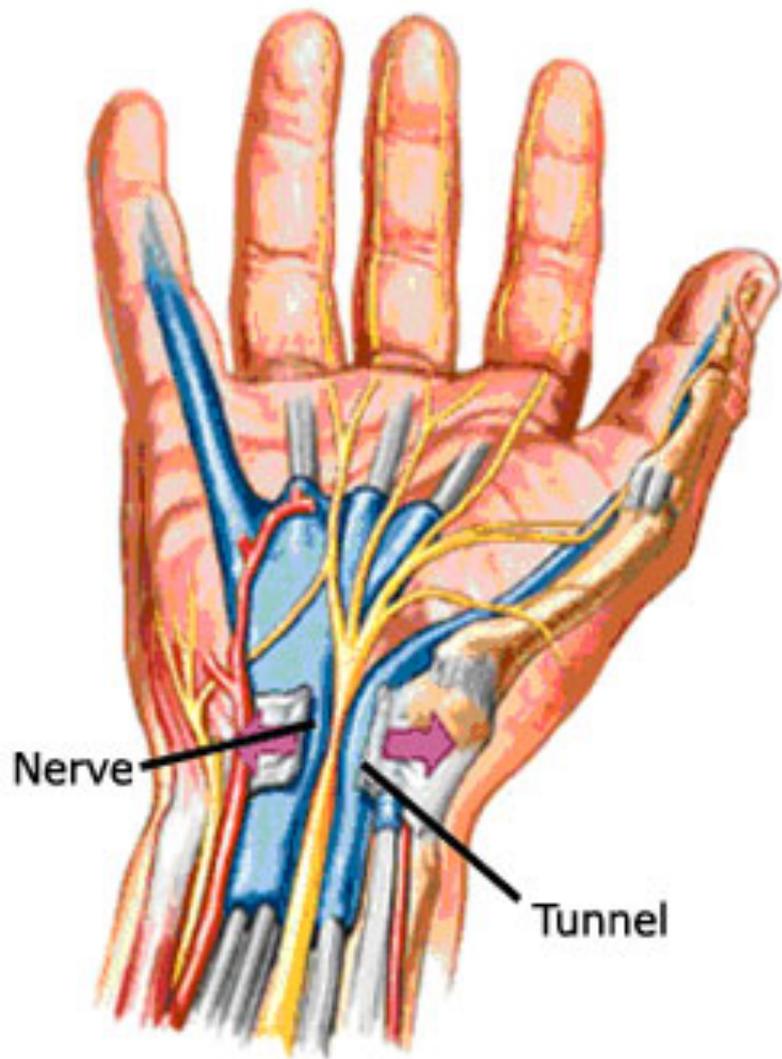
Inflammation of Achilles Tendon



Carpal Tunnel Syndrome

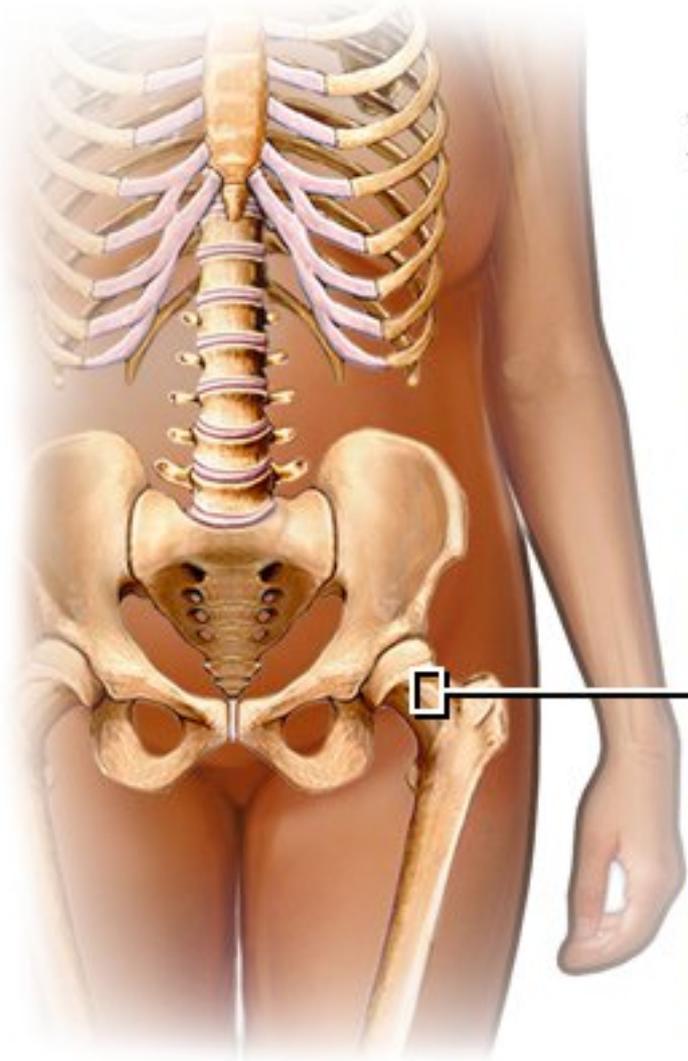
- Any condition that causes swelling or a change in position of the tissue within the carpal tunnel can squeeze and irritate the median nerve. Irritation of the median nerve in this manner causes tingling and numbness of the thumb, index, and the middle fingers, a condition known as "carpal tunnel syndrome."



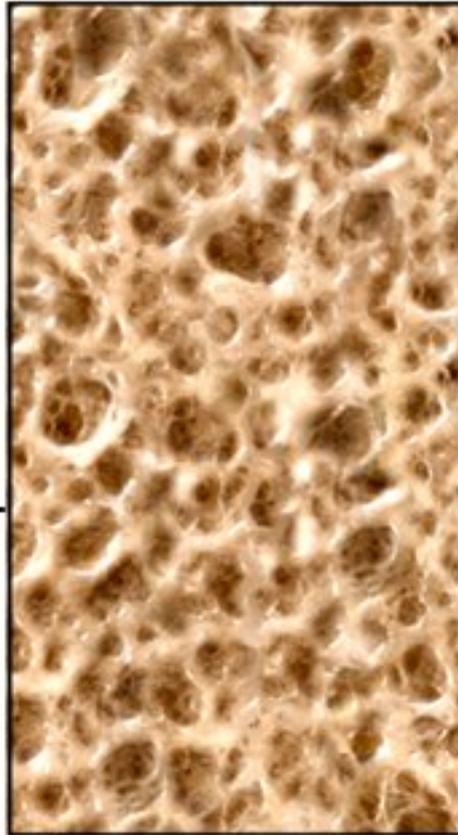


Osteoporosis

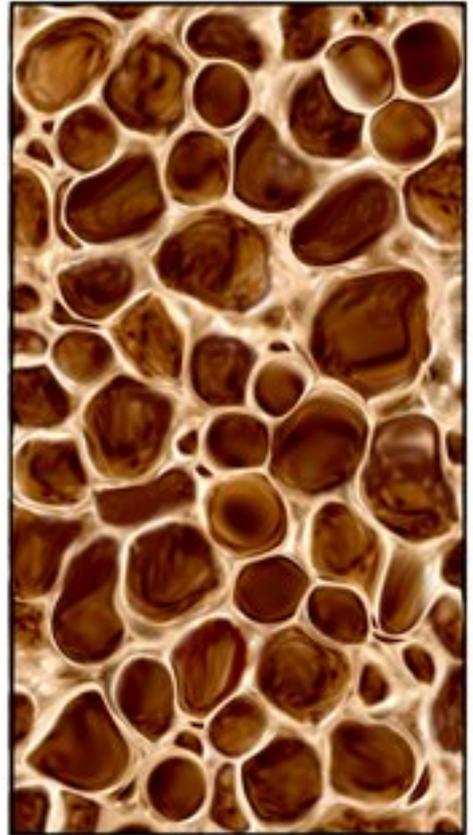
- Osteoporosis is a term that means "porous bones." It is a skeletal disease affecting women and men. Osteoporosis is a condition in which bones have lost minerals especially calcium making them weaker, more brittle, and susceptible to fractures (broken bones). Any bone in the body can be affected by osteoporosis, but the most common places where fractures occur are the back (spine), hips, and wrists.



Normal bone matrix

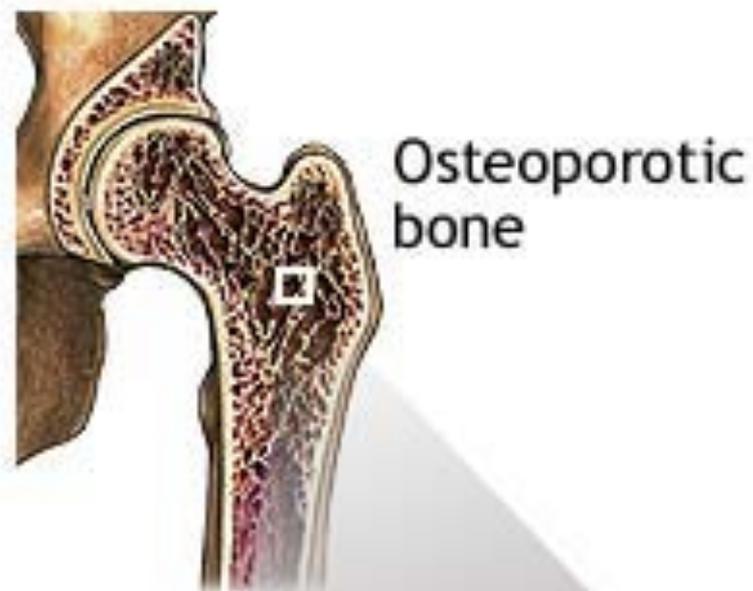
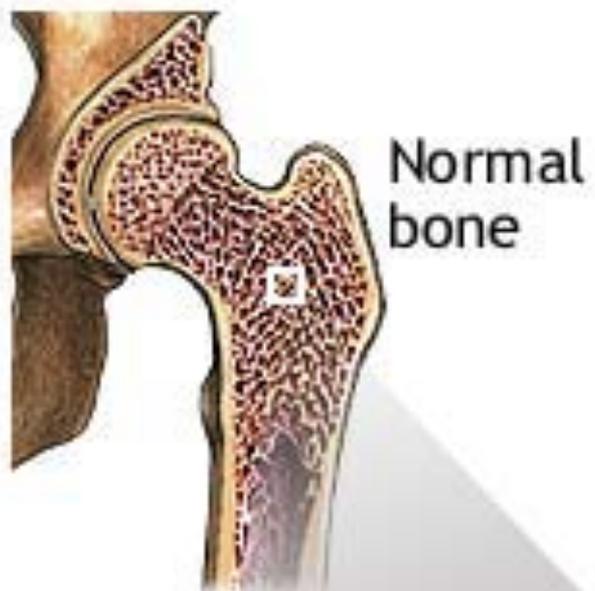


Osteoporosis



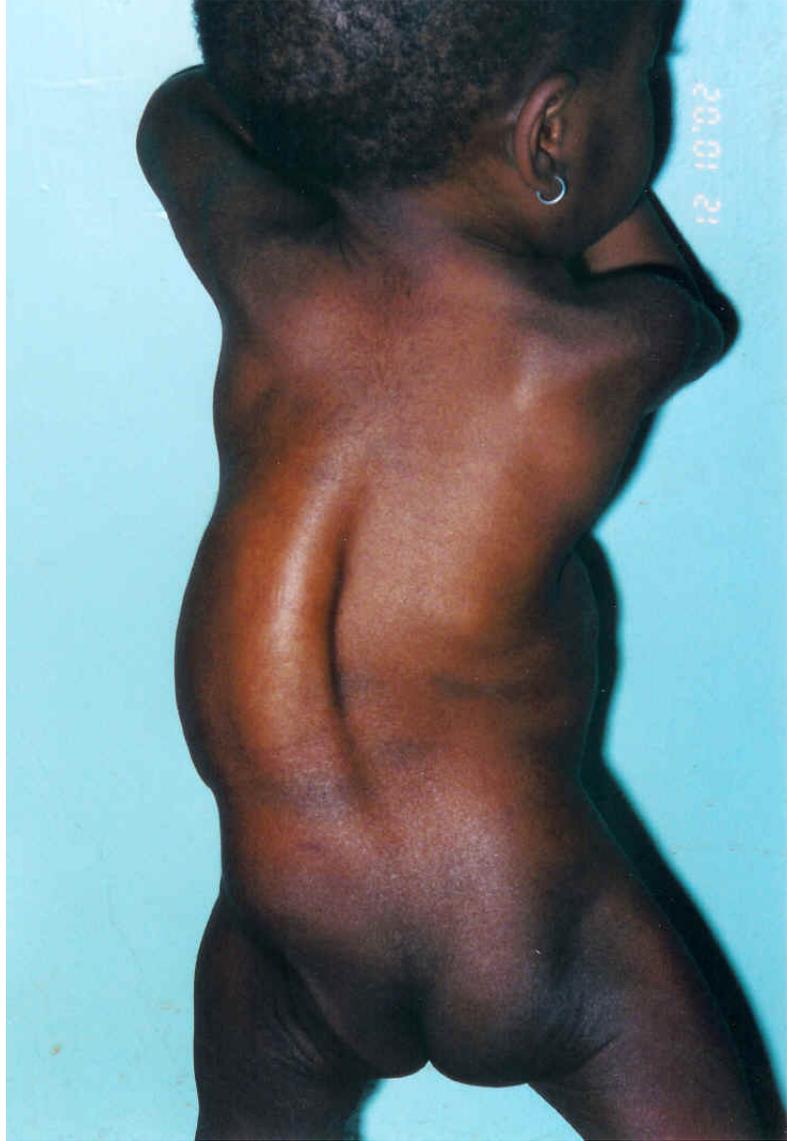


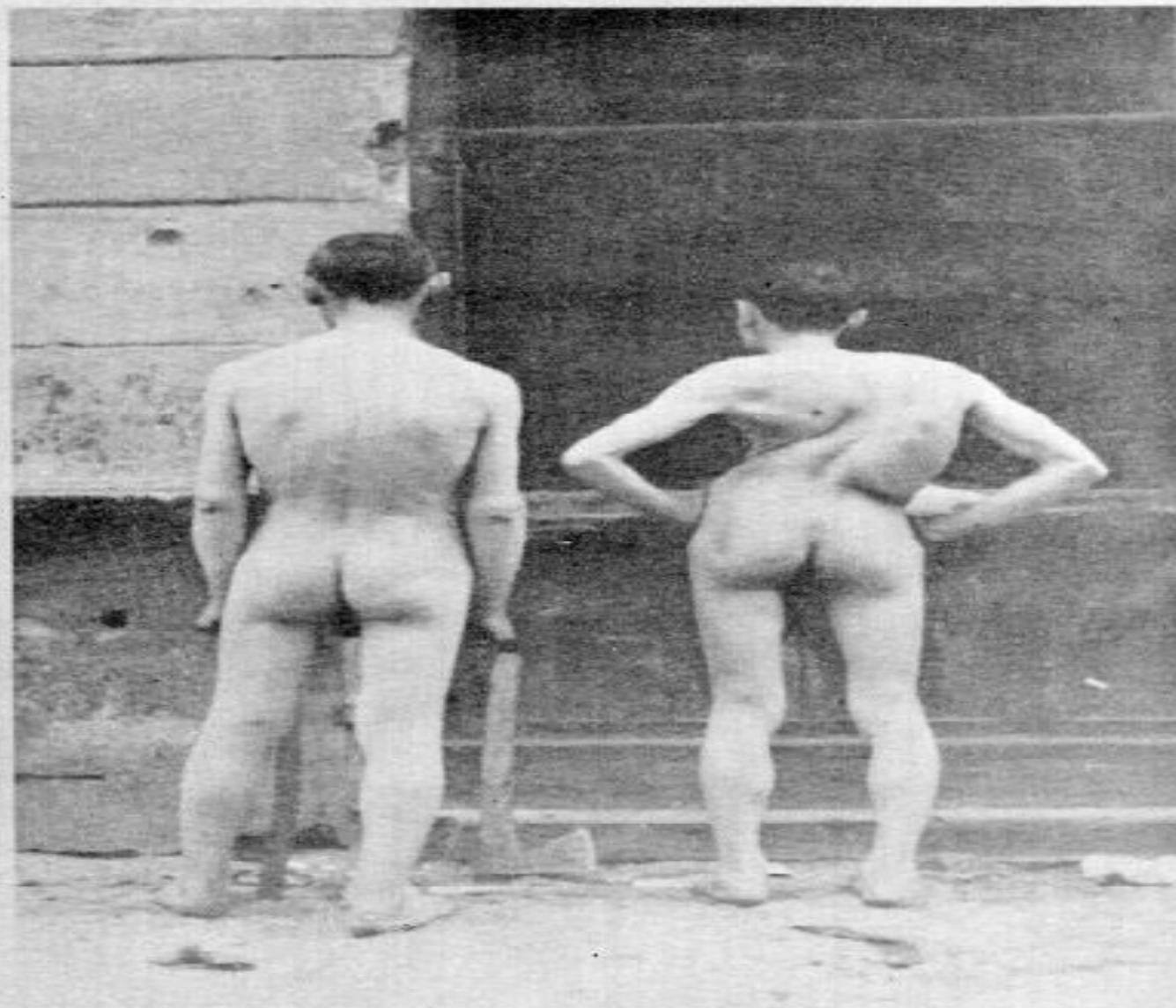
Deterioration of
vertebral support



Scoliosis

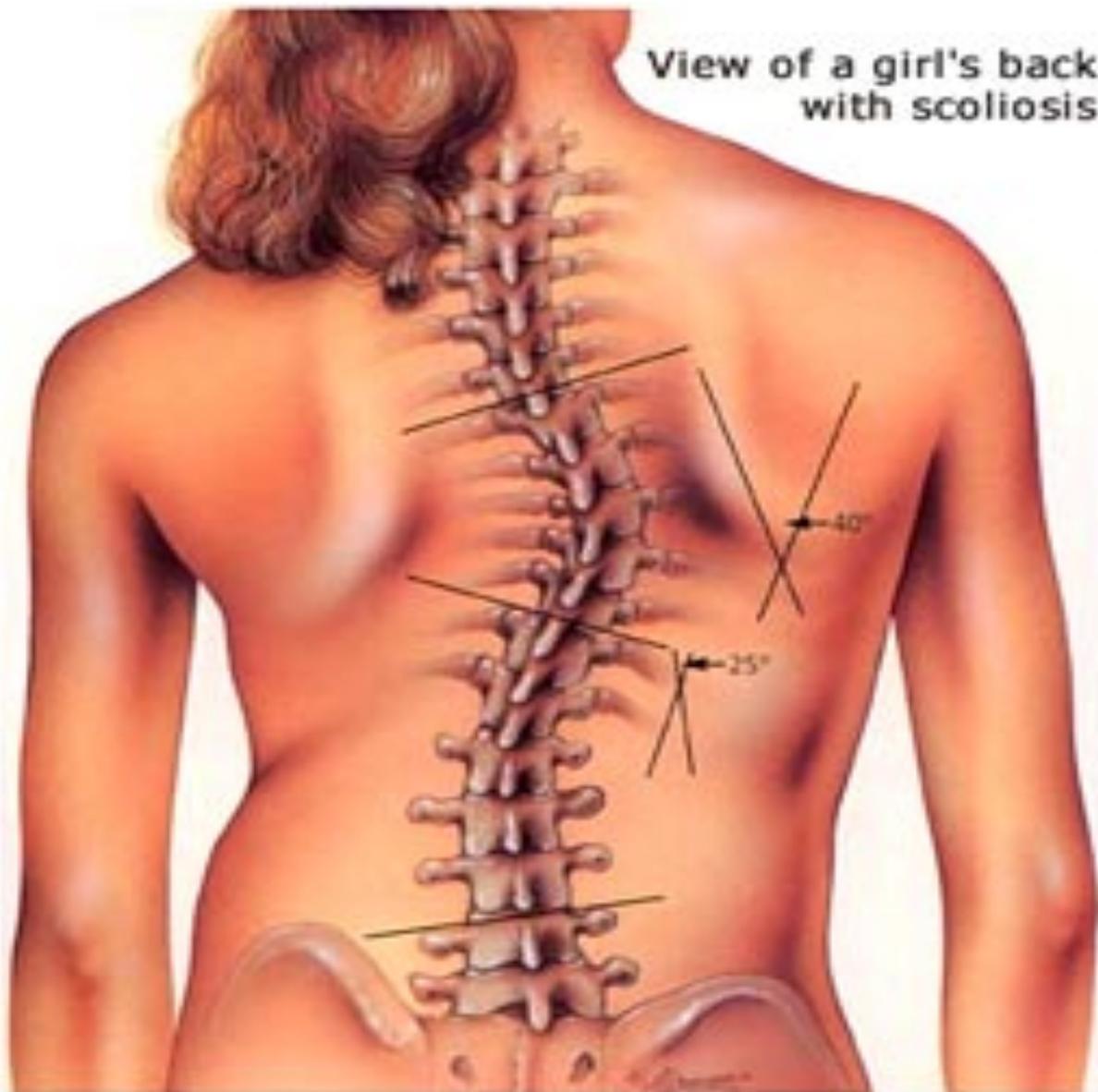
- Scoliosis is an abnormal curvature of the spine. If your child has scoliosis, the view from behind may reveal one or more abnormal curves. Scoliosis runs in families, but doctors often don't know the cause. More girls than boys have severe scoliosis. Adult scoliosis may be a worsening of a condition that began in childhood, but wasn't diagnosed or treated. In other cases, scoliosis may result from a degenerative joint condition in the spine.

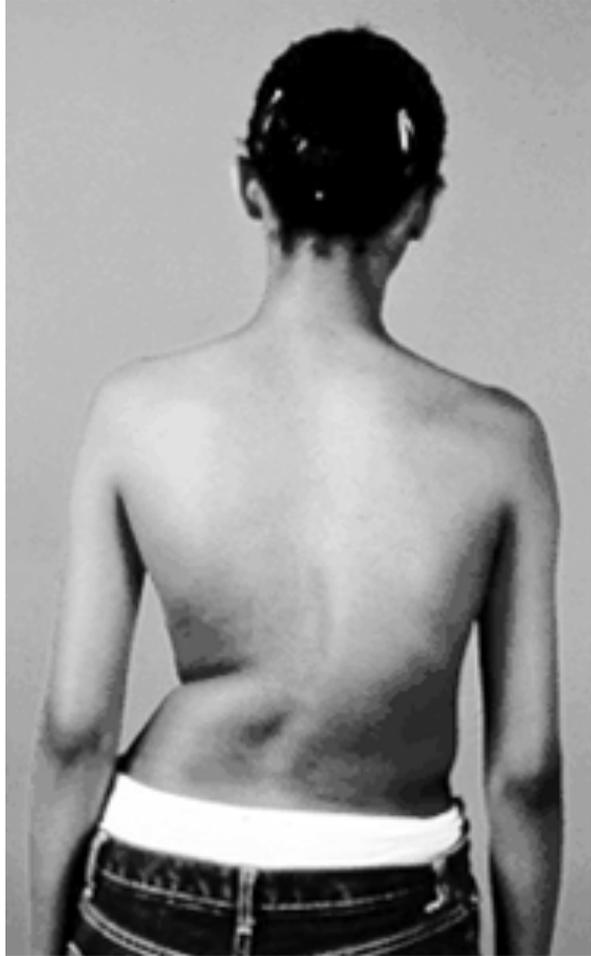




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View of a girl's back
with scoliosis





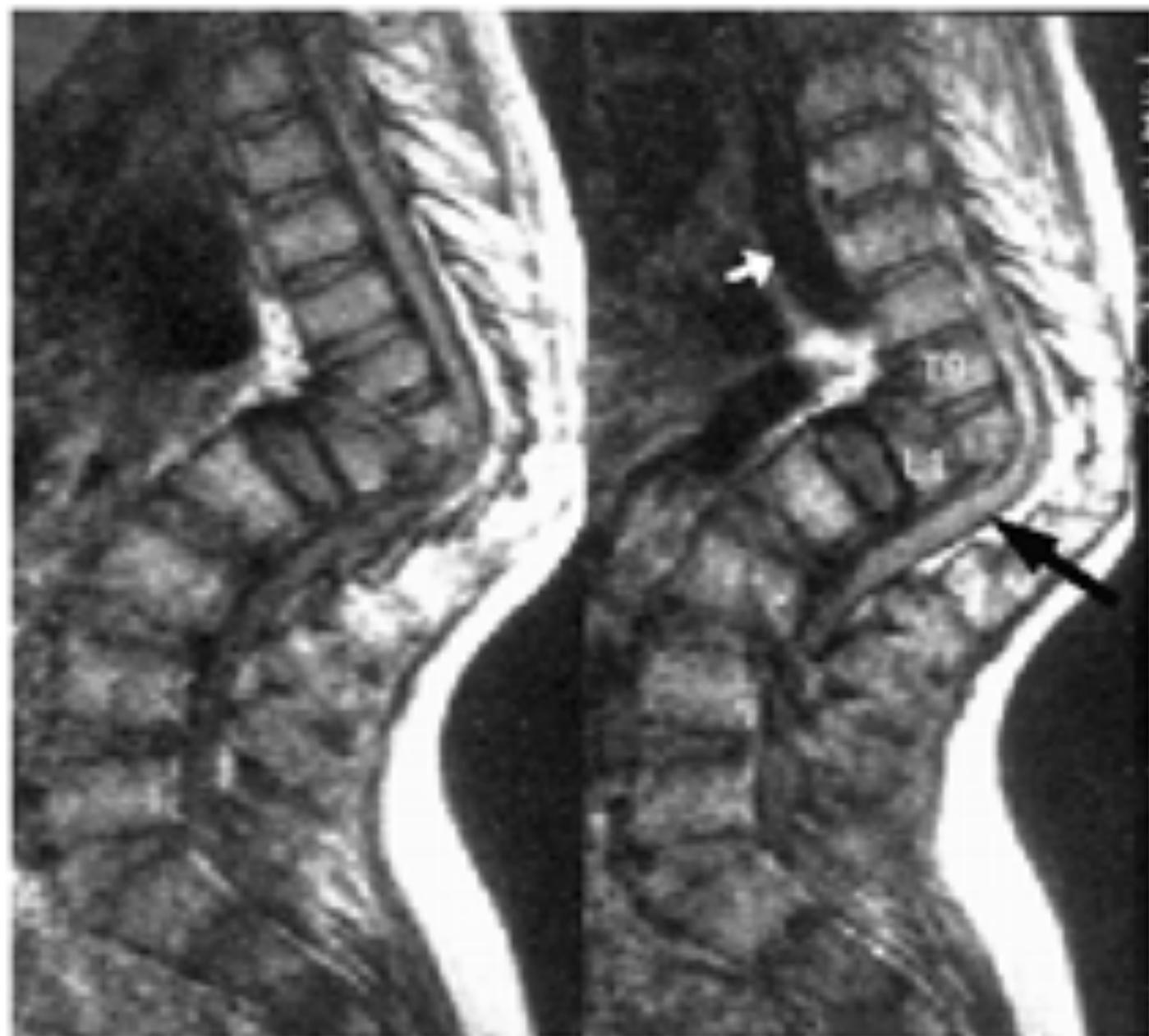
Kyphosis

- With kyphosis, your spine may look normal or you may develop a hump. Kyphosis can occur as a result of developmental problems; degenerative diseases, such as arthritis of the spine; osteoporosis with compression fractures of the vertebrae; or trauma to the spine. It can affect children, adolescents and adults.



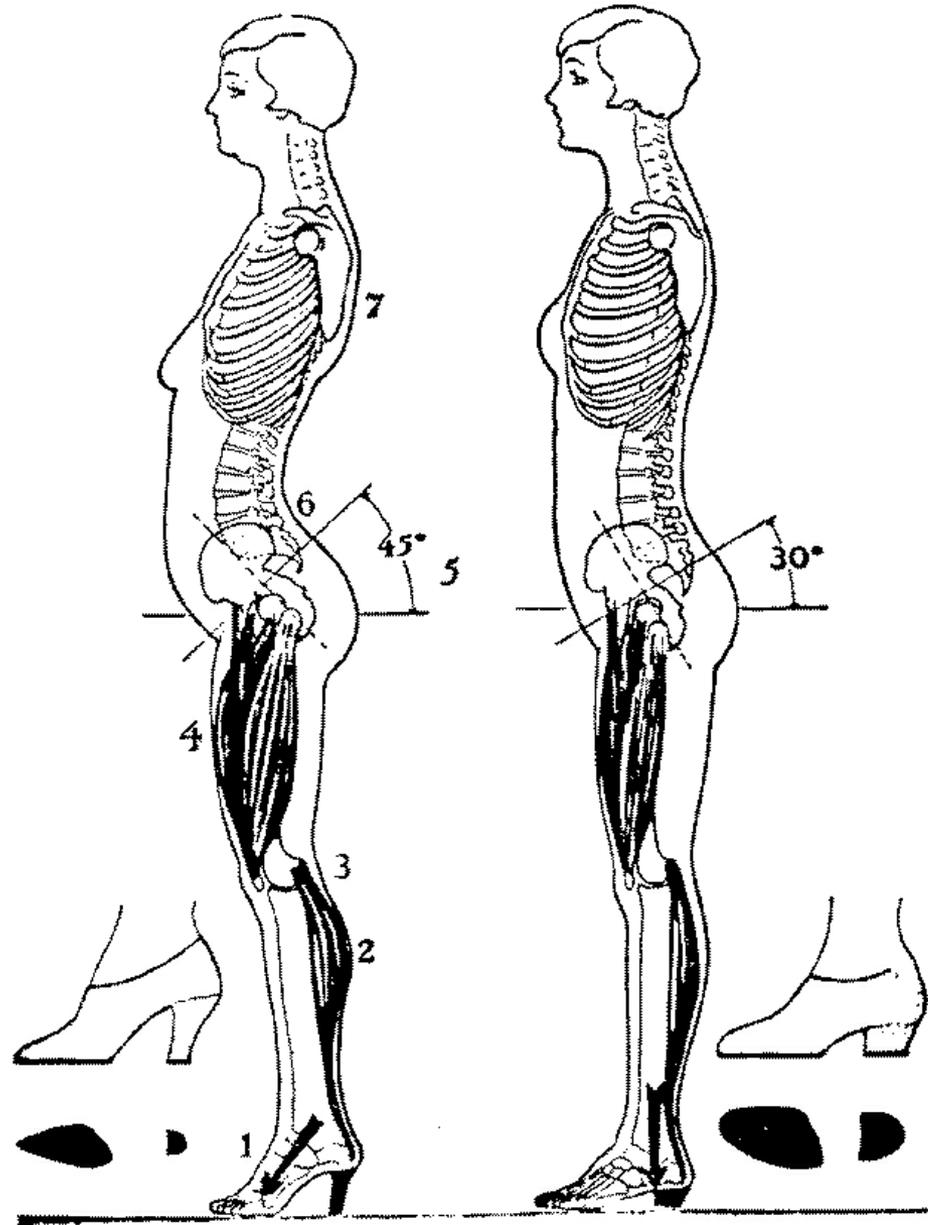
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An adolescent male presents with excessive roundback localized to the thoracic spine. The severe kyphosis is most obvious when he bends forward.



Lordosis

- A normal spine, when viewed from behind appears straight. However, a spine affected by lordosis shows evidence of a curvature of the back bones (vertebrae) in the lower back area, giving the child a "swayback" appearance.



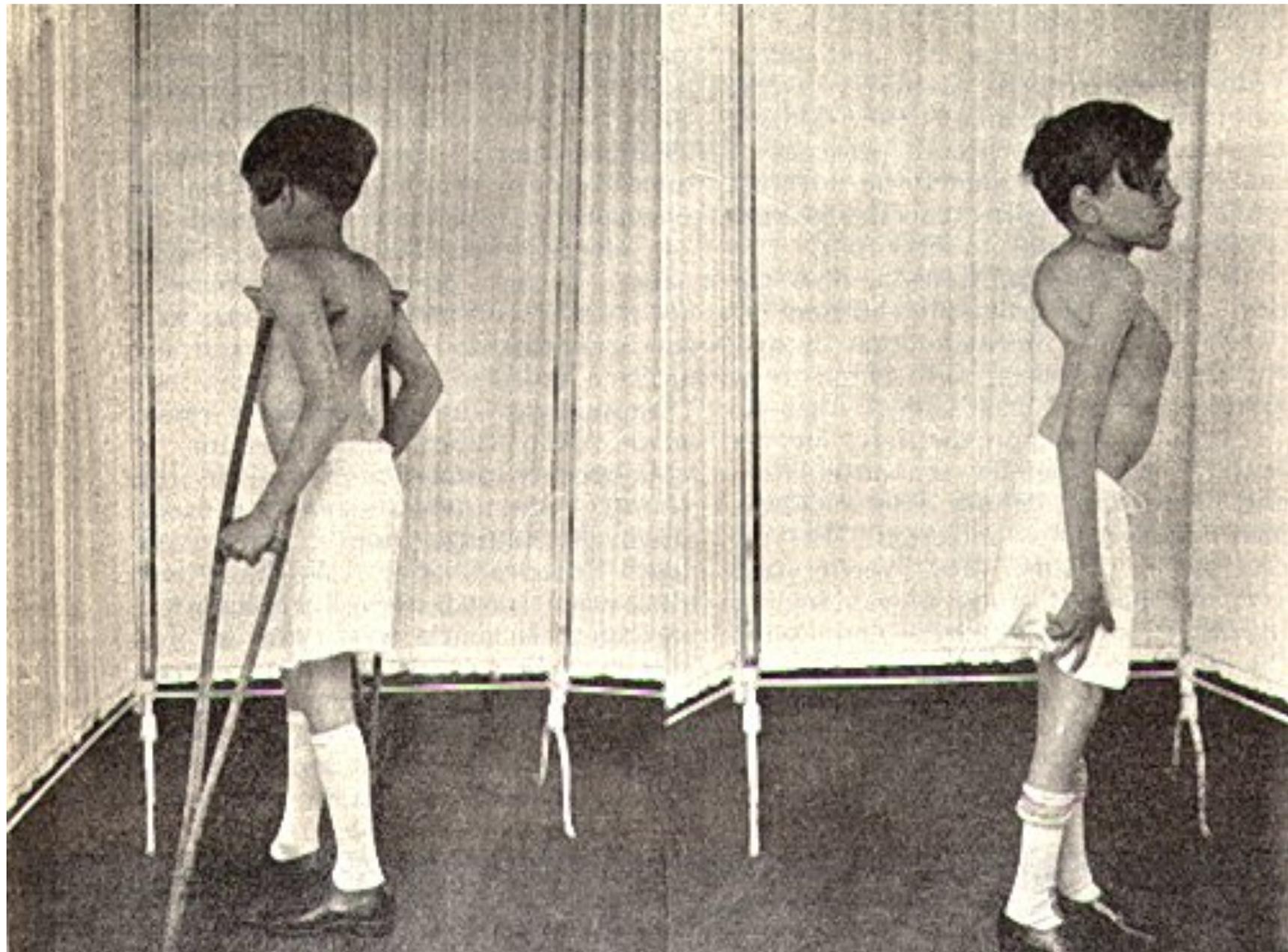


Tuberculosis of the Spine- Pott's Disease

- As a form of extrapulmonary [tuberculosis](#) that impacts the spine, Pott's disease has an effect that is sometimes described as being a sort of [arthritis](#) for the vertebrae that make up the spinal column. More properly known as tuberculosis spondylitis, Pott's disease is named after Dr. Percivall Pott, an eighteenth century surgeon who was considered an authority in issues related to the back and spine. Pott's disease is often experienced as a local phenomenon that begins in the thoracic section of the spinal column. Early signs of the presence of Pott's disease generally begin with back pain that may seem to be due to simple muscle strain. However, in short order, the symptoms will begin to multiply.







Rickets

- Rickets is the softening and weakening of bones in children, usually because of an extreme and prolonged vitamin D deficiency.
- Some skeletal deformities caused by rickets may need corrective surgery.





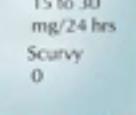


Scurvy

- **The human body lacks the ability to synthesize and make vitamin C and therefore depends on exogenous dietary sources to meet vitamin C needs. Consumption of fruits and vegetables or diets fortified with vitamin C are essential to avoid ascorbic acid deficiency. Even though scurvy is uncommon, it still occurs and can affect adults and children who have chronic dietary vitamin C deficiency.**



Vitamin C Deficiency (Scurvy)

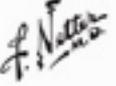
Sources of vitamin C	Major sites of concentration in body	Normal and abnormal values	
 Breast milk	 Citrus fruits	 Suprarenal cortex	 Urine: Normal 15 to 30 mg/24 hrs Scurvy 0
 Potatoes	 Pituitary gland	 Normal 0.5 to 1.0 mg/100 ml Scurvy 0 to 0.1 mg/100 ml	
		 Leukocytes	 Bluff coat: normal 15 to 25 mg/100 ml Scurvy < 2 mg/100 ml


 Positive Rumpel-Leede test


 Swollen, congested, bleeding gums


 Multiple perifollicular hemorrhages


 Typical leg position, scorbutic rosary, perifollicular hemorrhages





Gout

- Gout is a disease that results from an overload of uric acid in the body. This overload of uric acid leads to the formation of tiny crystals of urate that deposit in tissues of the body, especially the joints. When crystals form in the joints it causes recurring attacks of joint inflammation ([arthritis](#)). Chronic gout can also lead to deposits of hard lumps of uric acid in and around the joints and may cause joint destruction, decreased kidney function, and [kidney stones](#).

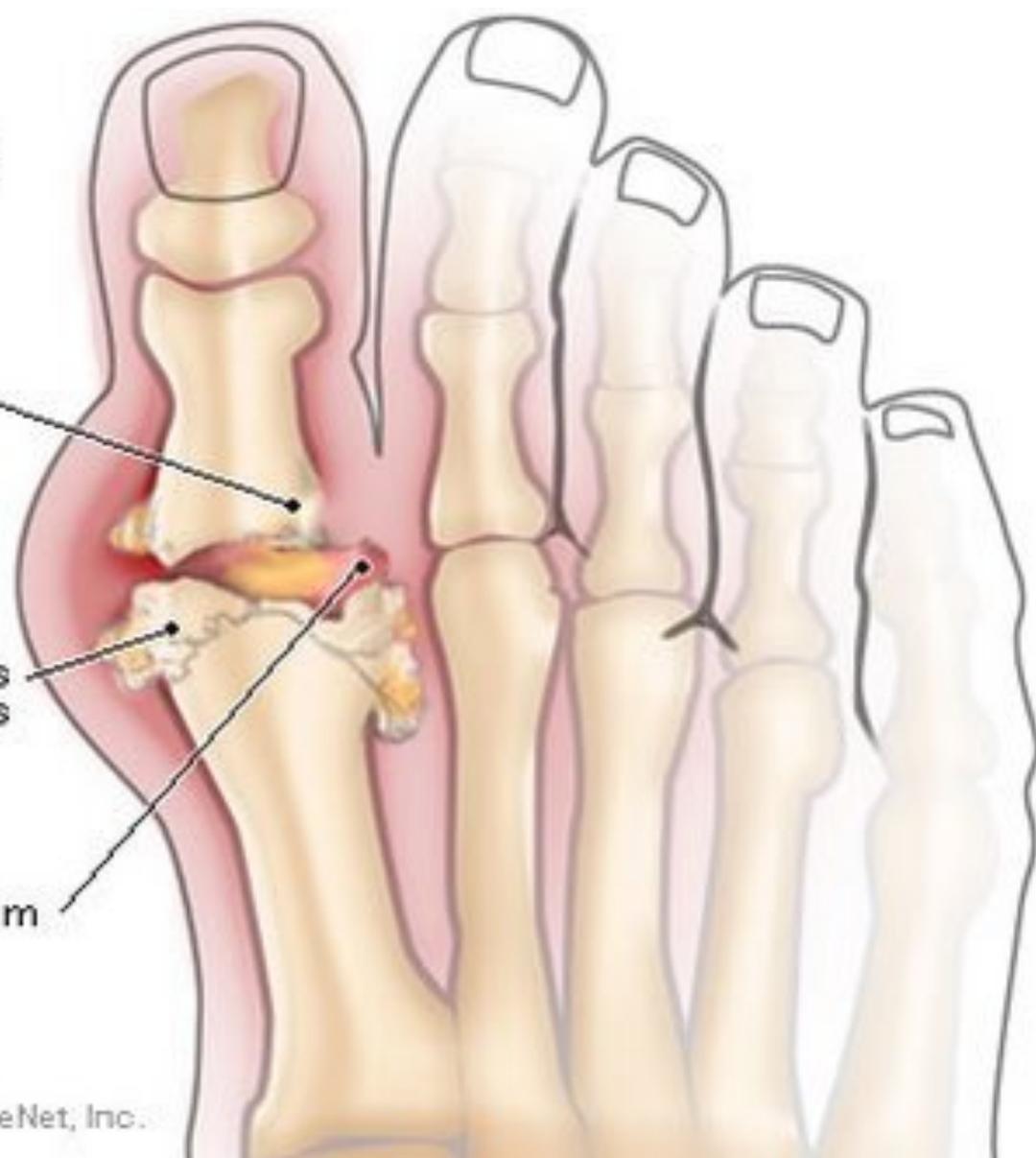
Gout

Bone erosions

Urate crystals
in a tophus

Synovium

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Acromegaly

- Acromegaly is a serious condition that occurs when the body produces too much of the hormones that control growth. • The hormone most often affected is called growth hormone, or GH. It is produced by the pituitary gland, a tiny organ at the base of the brain. • • Growth hormone promotes growth of bone, cartilage, muscle, organs, and other tissues. • • When there is too much growth hormone in the body, these tissues grow larger than normal. This excessive growth can cause serious disease and even premature death.



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Poliomyelitis

- **Poliomyelitis (polio) is a highly infectious disease caused by a virus. It invades the nervous system, and can cause total paralysis in a matter of hours. It can strike at any age, but affects mainly children under three (over 50% of all cases). The virus enters the body through the mouth and multiplies in the intestine. Initial symptoms are fever, fatigue, headache, vomiting, stiffness in the neck and pain in the limbs. One in 200 infections leads to irreversible paralysis (usually in the legs). Amongst those paralysed, 5%-10% die when their breathing muscles become immobilized. Although polio paralysis is the most visible sign of polio infection, fewer than 1% of polio infections ever result in paralysis. Poliovirus can spread widely before cases of paralysis are seen. As most people infected with poliovirus have no signs of illness, they are never aware they have been infected. After initial infection with poliovirus, the virus is shed intermittently in faeces (excrement) for several weeks. During that time, polio can spread rapidly through the community.**





Paralytic residua of
spinal poliomyelitis



Scoliosis



Multiple crippling
deformities:
contractures,
atrophy, severe
scoliosis and
ectopia

Genu
recurvatum
atrophy
limb



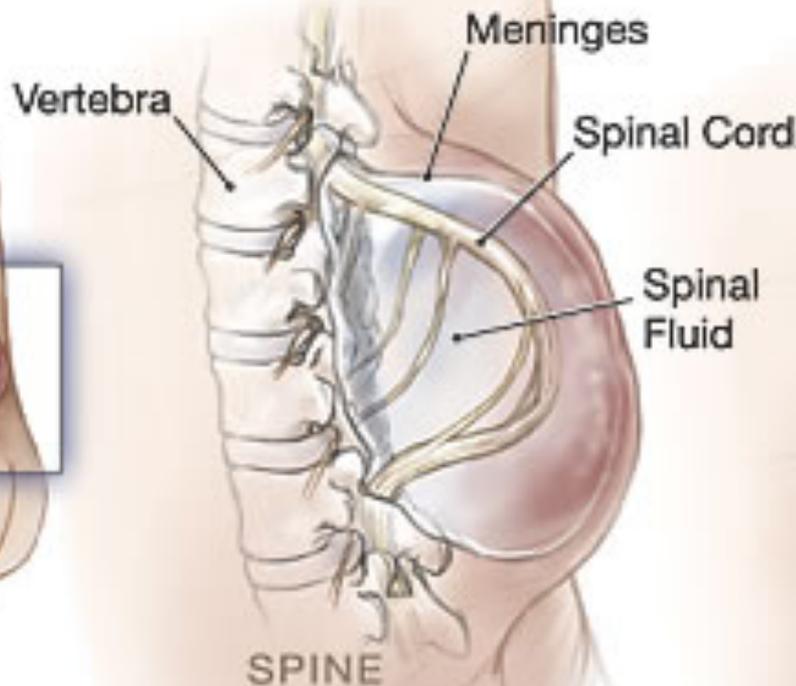
Netter
M.D.

Spina Bifida

- Spina bifida is a birth defect that involves the incomplete development of the spinal cord or its coverings. The term spina bifida comes from Latin and literally means "split" or "open" spine. Spina bifida occurs at the end of the first month of pregnancy when the two sides of the embryo's spine fail to join together, leaving an open area. In some cases, the spinal cord or other membranes may push through this opening in the back. The condition usually is detected before a baby is born and treated right away.



Spina Bifida



Normal Spine



C. Lynn





Talipes Equinovarus- “Clubfoot”

- Clubfoot is a deformity of the whole foot that is present at birth. There are several types of clubfoot that are jointly known as 'talipes', as the deformity is mostly in the talus (a bone in the ankle). The most common of the talipes is what is known as "talipes equino varus" - it is so common that the word clubfoot is commonly used to refer to this. In talipes equino varus, the child is born with the foot pointing down and twisted inwards at the ankle.



Clubfoot





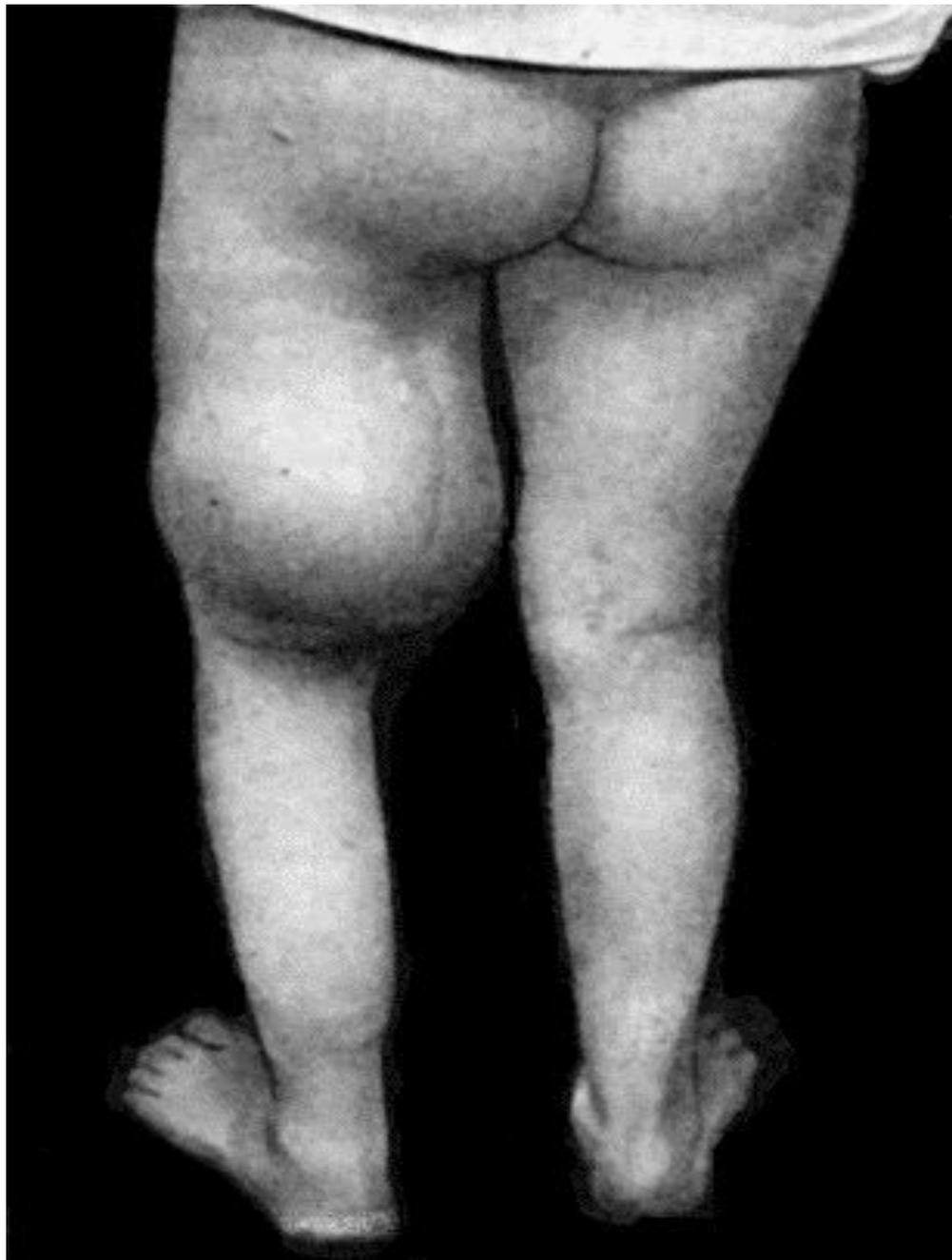


Sarcoma

- Osteosarcoma-The most common type of bone cancer. It arises in bone and is most commonly found in children and adolescents but a rare form occurs in adults, particularly in patients who have been cured of other cancers with radiation therapy.





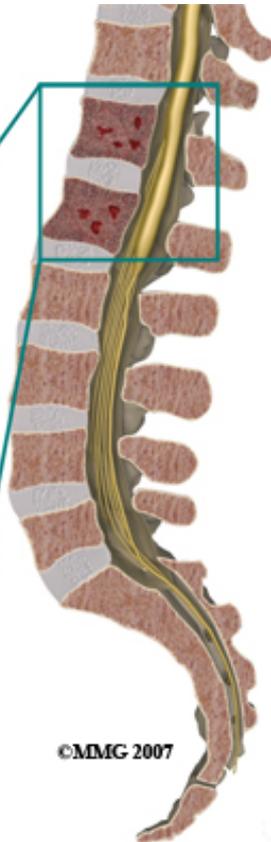
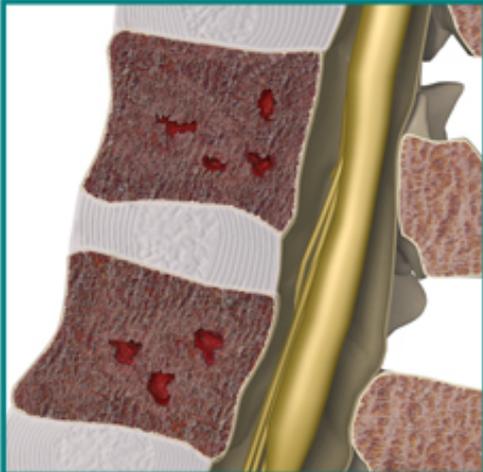




Myeloma

- Multiple myeloma is a cancer in which abnormal cells collect in the bone marrow and form tumors. Sometimes these abnormal cells (called myeloma cells) collect in only one bone and form a single tumor known as a plasmacytoma. However, in most cases, the myeloma cells collect in many bones, forming several tumors and causing other problems. When this happens, the disease is called multiple myeloma.

Multiple Myeloma



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Multiple myeloma



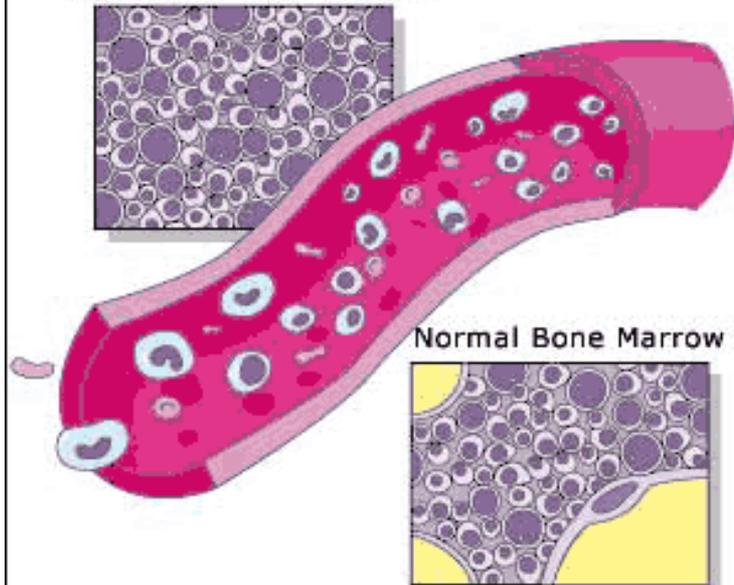


Leukemia

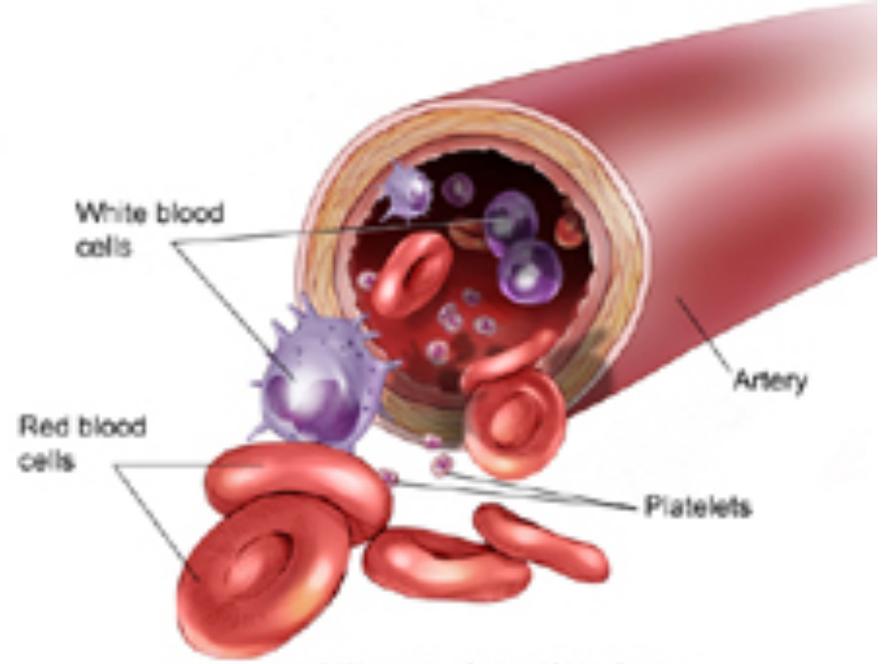
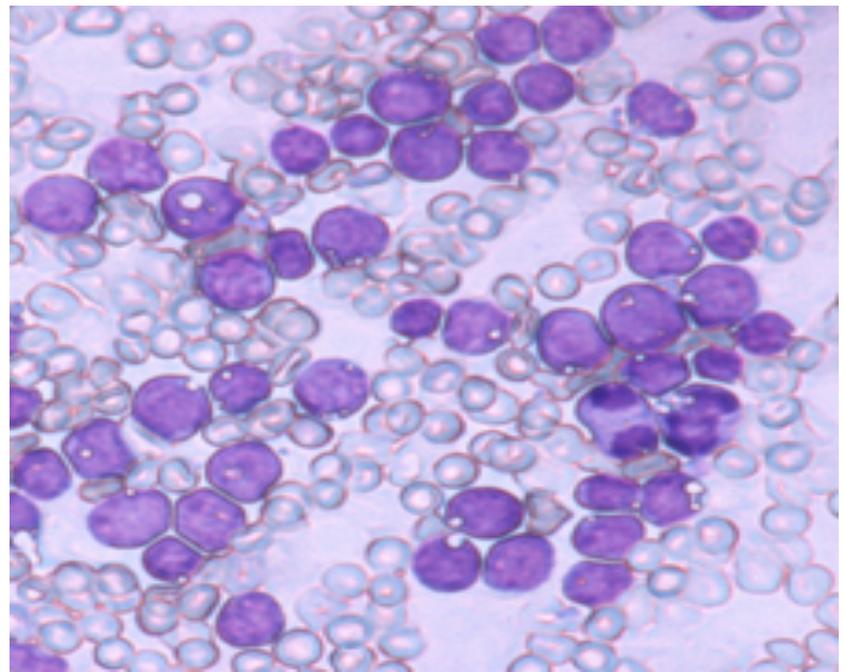
- Leukemia is cancer of the blood cells. It starts in the bone marrow, the soft tissue inside most bones. Bone marrow is where blood cells are made. When you are healthy, your bone marrow makes: • White blood cells, which help your body fight infection. • Red blood cells, which carry oxygen to all parts of your body. • Platelets, which help your blood clot. When you have leukemia, the bone marrow starts to make a lot of abnormal white blood cells, called leukemia cells. They don't do the work of normal white blood cells, they grow faster than normal cells, and they don't stop growing when they should.

Leukaemia

Abnormal Proliferation of Cells in Bone Marrow



Robert Marmolshaus Explorations LLC





Bone Marrow Biopsy

